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Automatic Feed Pump and Receiver.

The engraving which we present herewith represents the apparatus for draining coils, radiators, heaters, drying cylinders, steam jackets, etc., made by the Knowles Steam Pump Works, 93 Liberty street, New York. The practice of this firm has been to mount the receiver immediately over the pump. The engraving shows how it may be arranged alongside the pump, thereby saving head room.

The condensed steam enters the receiver at the nozzle, indicated by the arrow. As water accumulates it raises a float in the receiver, which, through suitable mechanism, opens the balanced steam throttle, starting the pump. If the accumulation of water in the receiver is slow, the pump will work correspondingly slow; if the water enters the receiver fast, then the throttle will be opened wider, thereby increasing the speed of the pump. Of course the float will operate to stop the pump if no water flows to the receiver.

Floats used for purposes like this frequently give trouble through filling with water, till they cease to operate; this cannot occur with this float, as its interior is connected with the exterior atmosphere through the hollow arm.

This arrangement will, of course, feed the water to the boiler at any temperature due to the pressure, thus avoiding loss of heat by reducing the temperature.

Electric Welding.

BY C. J. H. WOODBURY, BOSTON, MASS.

A PAPER PRESENTED AT THE SCRANTON MEETING OF MECHANICAL ENGINEERS.

The smith is the highest type of handicraftsman; he alone of all artisans making his own tools and also those of others, commands the dependence of all upon his offices. His work is prehistoric, reaching beyond records or traditions, and known to have existed in still earlier times through the personifications of mythology, wherein Vulcan was essential to other divinities. The blacksmith is a factor in every stage of the history of mankind; and his work is now, and always has been, a matter of individual skill, depending upon a keen eye and steady hand, with a fine sense of form and dimension, untouched by the flood of invention which has modified or even recast other methods of production.

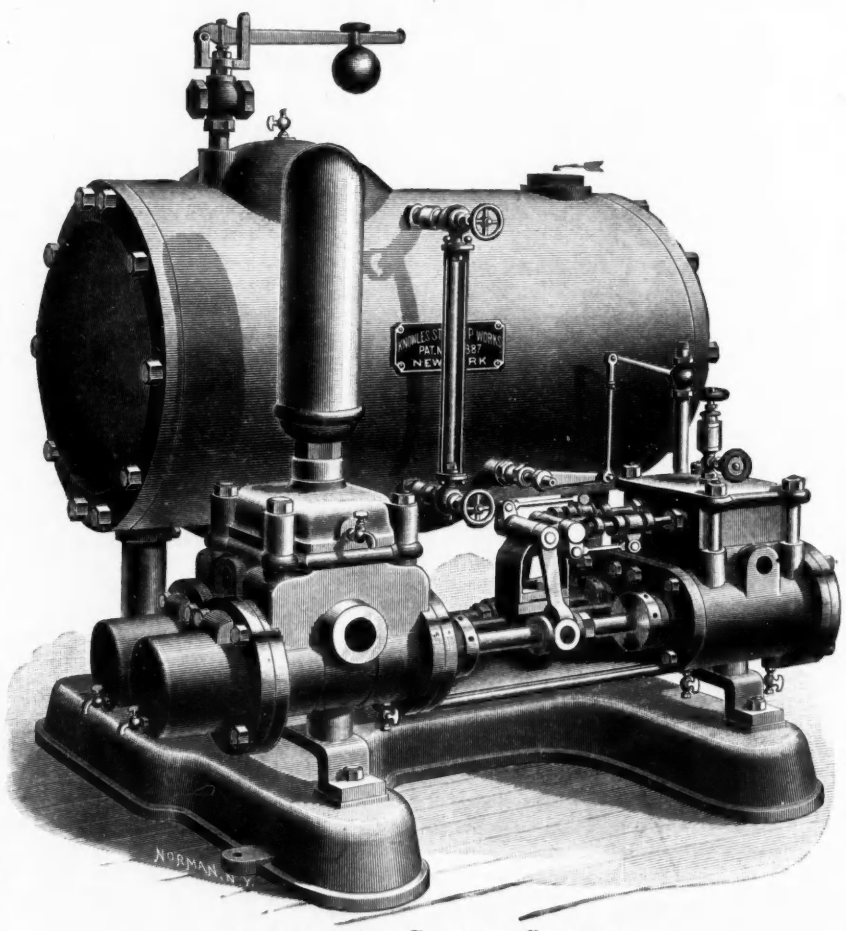
It is true that machinery is used in welding, but it is merely devoted to the application of power to supplement the limits of human strength; and with trip-hammer and crane the same skill is necessary as with hammer and anvil.

Since the first of the year there has been a commercial application of electric welding, the invention of Prof. Elihu Thomson, which has already reached a degree of importance sufficient to render it a live issue in every branch of manufacture to which it has been shown to be applicable.

This process is a new art; for, unlike the smith who is confined to iron, steel and platinum, it can weld any two pieces of the same metal or alloy, ranging from the most refractory metals to the alloy which fuses at 162° Fahrenheit. It will join dissimilar metals when the welding point of one is not too far in excess of the fusion point of the other.

These results seem to indicate that the classification of metals into welding and non-welding has been due to imperfections in the ordinary and time-honored methods, rather than any peculiarity in physical constitution warranting such arbitrary classification.

It is true that some of the metals have been joined without solder by means of the autogenous soldering process, wherein local fusion is produced with an oxyhydrogen blowpipe, but that laboratory experiment is not a union of metals heated to a plastic condition which precedes fusion, according to the accepted meaning of welding.



AUTOMATIC FEED PUMP AND RECEIVER.

Passing by the scientific interest of electric welding, a short allusion will be made to the principles upon which it is based as preliminary to a description of the apparatus, and then consideration will be given to its practical applications.

THE PRINCIPLES.

All forms of matter possess in varying degree the susceptibility of permitting the molecular motion necessary for the transfer of electric energy; those whose characteristics are favorable for such motion being termed conductors, and those which do not readily permit such motions are called non-conductors or insulators; and various adjectives are frequently used to express in a general way some sense of their value, but throughout the whole list of all known matter there is some measure of conductivity, and the whole expression is one of degree; the conductivity of silver, for example, being over one hundred billion times that of glass; and other materials possess measures of conductivity lying between these extremes. The ability of any body to conduct electricity in comparison with others of its kind is directly as the area of the cross-section and inversely as the length.

Whenever electricity is provided with what is termed a good conductor, it makes no manifestation of its presence, but if there is poor conductivity by reason of small cross-section or poor conductivity of the material, there is resistance to the electricity. Then a portion of the electric energy is expended in producing excessive molecular motion, and converted into heat, which is radiant if the temperature is high enough, as in the case of the incandescent light, when the metal portion of the circuit possesses ample conductivity to carry the electricity without appreciable heating, but the carbon filament in the lamp is a poor conductor, both in regard to physical characteristics of the material and small cross-section, and the molecular motion is so violent as to produce a temperature sufficiently great to contain light rays.

The total amount of mechanical work done by a current C in overcoming a resistance R during a time T, is $R C^2 T$; and the equivalent amount of heat is obtained by dividing the expression by J, the mechanical equivalent of heat.

$$H = \frac{R C^2 T}{J}$$

In an induction coil, electricity of large current and low pressure is converted into an equivalent electrical energy of small current and high pressure, by means of a bar of soft iron or a bundle of wires wrapped with two coils of insulated wire of different lengths and diameters. An alternating current being sent through the shorter wire alternately magnetizes and demagnetizes the iron bar with reversed magnetic polarity, and reversals of magnetism in this bar in turn produce an alternating current in the circuit of which the secondary coil is a portion; the secondary current being, as stated above, of high potential and small quantity.

By suitable structural changes, an induction coil can be inverted as to its functions, and used to convert small electric currents into large ones, with inverse changes in potential.

THE APPARATUS.

The electricity is generated by one of two methods. In the direct system the dynamo is contained in the machine below the clamps, and the armature contains two windings; the one being a fine winding which is in series with the field magnet coils, and the other winding being merely a bar of copper in the form of a letter U, or less than a single coil. This bar being of very low resistance, the maximum current is sufficient for welding purposes, and the terminals are connected directly to the copper clamps. Alternating currents are generated in this machine, and used for welding, in order to avoid commutators, which are necessary in direct current machines. It should be remembered that in all dynamos the electricity is generated in alternating currents, and that these currents are in proper turn fed to brushes of opposite polarity, and thus rendered continuous. In an alternating current dynamo the electricity is conducted from the armature to rings instead of to a commutator, and is thus better suited for large currents, and some forms of the apparatus do not require rings or any moving contacts. There is no electrical reason why an alternating current should be used except the convenience of its manipulation. In fact, the continuous current supplied by secondary batteries has been used for this purpose.

Another form of apparatus, termed the indirect system, is more conveniently suited for large work, or in places where a number of welding machines are operated by the current from a single dynamo. The welding current is produced by conversion of the comparatively high tension current by means of an inverted induction coil, termed a transformer. The primary circuit from the dynamo is conducted through many turns of fine wire wound around a soft iron ring, and upon this same ring is a single turn of a large copper bar, in which the welding current is produced by inductive effect. These currents receive 4,000 to 15,000 alternations per minute. The welding currents are not changed suddenly or by switches, as such manipulation would not be desirable or even practicable with the great currents used; but in the direct welding machine, a set of resistance coils is placed in the fine circuit which passes around the field magnets, and by interposing more or less of the resistance coils in this circuit, the strength of the magnet, is diminished or increased, and the welding current altered accordingly.

With the indirect machine, the amount of the secondary or welding current is controlled by varying the current in the primary coil by means of a kicking coil, or by a variable shunt to the field coils and in other ways.

In either case the apparatus is simple and in full and complete control at will of the operator by movement of a lever, and this action controls the heat.

THE PROCESS.

In the electric welding process, the two pieces to be joined are secured in firm end

contact by a pair of adjustable copper clamps, which are placed upon the top of the apparatus. An electric current of large volume is passed through the pieces, and the contact between them being of less conductivity than the homogeneous metal, heating ensues at this place, as the juncture is brought to the proper temperature by the gradual motion of the regulating lever, and as the metal softens, the clamps are pressed towards each other to insure a continuous metallic union across the bar.

The weld begins at the center and proceeds radially towards the surface, as the temperature becomes greater than at the interior. The heating is further increased by the fact that the resistance of the hot metal is greater than that of cold metal.

The enormous electric currents used in this welding process sometimes reach 50,000 amperes, but with an electro-motive force of half a volt, and therefore not capable of giving any sensation to a person.

It would be injudicious to offer any premium upon ignorance, but the operation of electric welding is one of the simplest of mechanical processes, requiring but little skill on the part of the operator in comparison with that exact training of hand and eye and long experience necessary for ordinary welding. The operator must understand the color of the proper welding heat of the metal under treatment, but this is readily learned. The work is not manipulated during the process, except when it is desired to reduce the burr at the weld, and is at all times under observation, and its heat subject to entire control by means of a lever, which graduates the strength of the current.

The dynamo generating the electricity is self-regulating, and requires no attention except for lubrication.

There is no unnecessary waste of fuel, the heating being local, and does not extend far from the weld; cotton-covered wire, one-fourth of an inch in diameter, can be welded without searing the insulation over three-fourths of an inch from the weld.

The time for making a weld varies from a fraction of a second to about two minutes, according to the work; although nothing over two inches diameter has yet been welded, but larger machines are in process of construction.

It is not necessary to provide motive power fully equal to the maximum demand, as the time is so short that the momentum of a fly-wheel will serve the same purpose as in a drop press, and give up the surplus energy required.

The power is inversely proportional to the time, and appears to be about proportional to the 2.3 power of the diameter in inches, with a slight variation in favor of quick work caused by differences in rates of thermal conductivity of the material.

APPLICATIONS.

The process is far cheaper than that of hand welding, and also extends to other methods of manufacture, but the comparative expense differs according to the previous conditions in every place where it has been applied thus far.

Its applications in practical work thus far have been confined to butt welding for many purposes, such as continuous wire work, carriage work, axles and tires, cotton bale ties, barrel hoops and wire cables, and many miscellaneous purposes. Axes are made of drop forgings, joining the tool steel edge to a mild steel poll, bars are heated in the middle and upset forming collars, and pipes are joined together—a matter of great value in ice machines. This list might be continued to greater length, but this indicates the range of its practical uses at this early day.

STRENGTH OF ELECTRIC WELDS.

The value of the process, for most purposes, independent from any scientific interest or mechanical ingenuity shown in the apparatus, must be that of the resistance of the welds under tensile stress.

It will be readily understood, however, that, as this process accomplishes many things hitherto impossible, aside from any question of ultimate strength, it is fitted for applications in many construction where it saves labor and time; provided only that the joints be in all cases sufficiently good for the purpose for which the article is designed. A large field thus opens up in the execution of ornamental design in metal work, where it will supplant screws, rivets or solder for fastenings, and in other evident applications.

There is no reason why such a weld should be stronger than the rest of the bar, but if averaging of equal strength, some of the breaks would occur at the weld.

The author then submitted a long table of tests made at the Watertown arsenal, of pieces electrically welded. The metals welded were steel, iron, iron to steel, copper, brass, brass to iron, steel to German silver, etc. The records of the tests go to show that the average strength of the pieces was about the same at the welds as elsewhere.

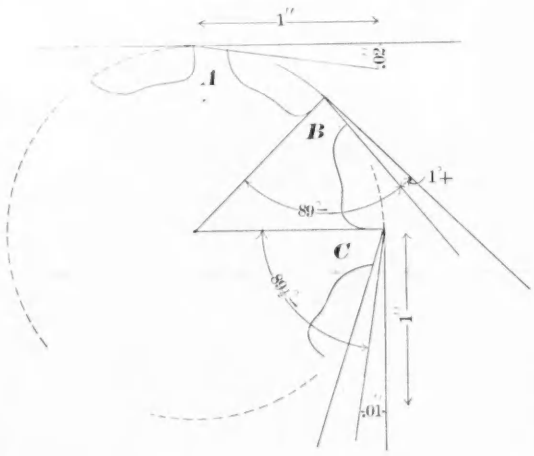
Shop Notes.

By Jarno.

No. 11.

THE TRUTH ABOUT A REAMER—THE TESTIMONY—EVIDENCE—PROOF—AND THE DECISION.

The reamer had sized and finished one hundred holes. The last hole appeared to fit the standard gauge, exactly the same as did the first hole. When the difference between two holes is one fifty-thousandth of an inch, it can be told with a good standard. Admitting that the workman can find a difference when it is one fifty-thousandth of an inch, and admitting that the reamer wears



uniformly, we have a tool that can ream five hundred holes, before losing size, one ten-thousandth of an inch. The one hundred holes were five-eighths inch diameter and one and a quarter inches long. It was not an expansion reamer.

The testimony of the man that used this reamer is that its success comes from three things: the taper of the teeth at the end of the reamer is not long, being about three-eighths of an inch; the taper part of each tooth does an equal share of the cutting, and the straight part of each tooth bears equally along its entire length; the teeth are smooth, and the temper has not been drawn in sharpening.

The reamer was sized with an oil stone. The teeth were relieved and sharpened with an oil stone.

A reamer like this one is sized and sharpened as follows: After the reamer is hardened it is ground to within about one-thousandth of an inch of the finished size, with a fine, free-cutting emery wheel. If a coarse emery wheel be used, it may be better to leave the reamer two one-thousandths of an inch larger than the finished size. The reamer is then held in a vise, and the teeth are relieved, or cleared, with a long oil stone. The stone is grasped in both hands and is used like a file. The teeth are relieved an amount that would be equal to about two one-hundredths of an inch in depth for one inch in width, as shown at *A*, Fig. 1. That is, this relief is a little more than one degree, as shown at the tooth *B*; the relief or clearance is brought just to the cutting edge of the teeth.

The reamer is then mounted in the centers of an engine lathe, and is accurately sized with a fine, hard oil stone. The stone is held in the tool post. The reamer is run backwards. Go up and back once with the oil stone, then carefully measure the reamer. Generally the reamer will, at first, be smaller at the two ends than in the middle, and of course the middle may have to be stoned more than the ends. Upon the accurate sizing of the reamer depends, in part, the successful reaming of the one hundred equally sized holes.

This sizing operation leaves a narrow land at the edges of the teeth. Now, with a fine, hard oil stone relieve this land, bringing the relief exactly to the edges of the teeth. This relief can be about half a degree, or one one-hundredth of an inch, in a width of one inch. We now have a tooth shaped like the enlarged sketch at *C*. The taper part of the teeth can be relieved upon the same principle, the relief being more at the taper part than at the straight part; say, let the taper relief be twice as great as that of the straight part.

The character of the man who gives me the foregoing is such that his testimony amounts to evidence leading to proof warranting the decision that a reamer, sized and relieved by an oil stone, is a most excellent tool. This is, no doubt, an old way of sizing and sharpening a reamer, yet, of all ways it is the best for smoothness of holes and for the life-time of the reamer. For most work such a refinement is not necessary. In many holes a limit of one one-thousandth of an inch can be allowed, and it is not economical to size them within a smaller limit. Generally it is well enough to grind the relief of the teeth and stone the edges.

Another man testifies to being told of one who sized a reamer with a brick. It is not thought best to put this testimony in as evidence, because the man did not actually see the brick. Perhaps some of the readers of the American Machinist can enlighten us upon the cutting properties of a brick. The subject is entirely out of my line of experience.

The decision is, that what we certainly know has some connection with our experience. Whoso does not abide by this decision, may, some time, follow a chimera.

"American Bridge Failures."

Before Section G of the British Association at Bath, Mr. George H. Thomson, an American engineer, read a paper on the subject of American Bridge Failures, which ought to make every American who reads it (as published in *Engineering*) blush with shame. There can be no denying that it is a true bill; and that such an array of facts as are presented in that paper can be brought forward, is a disgrace to American engineering and railroad management.

After reading the paper, one can scarcely escape the conviction—if indeed he has not before held the opinion—that comparatively few railroad bridges in this country have been designed and built with anything like a true conception of the requirements for such structures, and that it is true of many of them, as was said in the official report of Mr. J. W. Murphy, on the old Girard avenue wooden bridge in Philadelphia, in regard to that structure. He concluded a careful diagnosis of the case by saying, "And finally, I can see no engineering reason for this bridge standing at all, except it be—from force of habit." The record presented by Mr. Thomson shows that some of the bridges which have failed in this country did not stand long enough to acquire the habit of standing even; one instance being given in which a bridge was wrecked within a few hours of its completion, and we notice another instance where the road of which the wrecked bridge formed a part had been built but a few years. *Engineering* has prepared engravings of the photographs accompanying Mr. Thomson's paper, showing some of the wrecked bridges, an inspection of which is not at all calculated to inspire a feeling of confidence in the breast of an American who must occasionally place his life in the keeping of a railroad company.

We feel bound to say, however, that the exhibit is not so much a reflection upon American engineering ability, as upon American methods of railroad management. The most of the trouble, in our opinion, arises from the fact that all railroads in this country are built and managed with entirely too much regard to the interests of Wall Street.

Referring to the paper and its discussion, *Engineering* says:

In the absence of the author the paper was read by Mr. B. Baker. We have printed this paper *in extenso*, together with numerous illustrations taken from photographs that accompanied the contribution. The discussion was of a very brief character; indeed, the room was all but deserted, the audience having flocked out almost *en masse* at the conclusion of the reading of the preceding papers. It is much to be regretted that so valuable a contribution to engineering science as that of Mr. Thomson should not have been brought forward under more favorable auspices, so that it might have given rise to a complete and full discussion. When a distinguished American engineer comes forward and deals so freely with a subject on which he might well be excused for showing some reserve, it is a pity his English fellow-workers cannot profit to the full by the opportunity thus afforded to them. A good discussion on this paper should have been a leading feature of the meeting of the section, and had English bridge designers and constructors been as frank as Mr. Thomson, we should have found that there was a good deal to learn on both sides.

Mr. William Anderson, who occupied the chair in the absence of the president, referred to the great advantage of having a paper from an American engineer of such note as Mr. Thomson. It was a satisfaction to English engineers to know that they had, even if intuitively, adopted those principles of bridge construction which were now shown to be necessary to safety. In former years he had been connected with the construction of bridges, but he had not had any work of the kind pass through his hands for a long time. He was surprised to hear that the weight allowed per foot was now two tons, as one ton was considered enough in earlier days. The additional strain that might be set up by the action of the automatic brakes was also to be considered.

Mr. Beaumont said that it was quite an unexpected thing to find an American engineer coming forward to admit that American bridge construction was not as good as that followed in England. This had been for a long time past a point of controversy between the representatives of the two countries. If these bridges, which failed in the United States, had been in England, they would not have failed. One of the chief American papers had a standing paragraph, "The bridge failures this week are"—so many. Sometimes they were more and sometimes less, ranging, perhaps, between three and ten; and yet Americans were annoyed if we, in England, say that bridge failures are frequent across the Atlantic.

Mr. Baker, in replying to the discussion, remarked that there was very little to say. It had been asked why the paper was sent over to England, and the answer was simply because he had asked for it. Mr. Thomson was one of the most prominent authorities on the science of bridge construction in America, and no doubt he would have a warm time with his colleagues when they came to read what he had written. The speaker wished to mention one fact. Reference had been made to English engineers and United States engineers. Now engineers looked on themselves as engineers, and did not much consider whether they were English or American, for they claimed an interest in all that was done by the brotherhood, on whichever side of the Atlantic it might be. The question of nationality did not come in so far as the engineering aspect of the question was concerned; there was, in fact, no national feel-

ing. When an American spoke of the Institution of Civil Engineers, he meant the English institution, recognizing in it the parent society of engineers all over the world. If he wanted to refer to the American Institution, he called it the American Institution. It is a good thing that the bond of good-fellowship and scientific interest should be strong enough to overcome narrow and senseless jealousies. Patriotism is a great virtue, but few things are more absurd than a mistaken application of its principles.

A vote of thanks being proposed by the president and carried by acclamation, the next paper was taken.

Anti-Priming Pipes in Steam Boilers.

By W. H. Booth.

When no dome is fixed to a boiler it is usual to fit along the crown, internally and in communication with the steam outlet, a perforated pipe, termed an anti-priming pipe, whose duty it is to take steam from a considerable length of the boiler crown, and so avoid the priming, which is so common when the steam outlet is plain and open. It is usually considered sufficient for this pipe to have a length about one-fourth that of the boiler, and the best practice favors a pipe perforated along its upper side, and of a diameter of about 6 inches in a large boiler. Two or three small holes are made in the under side of the pipe, to drain it. Now experience has shown that these pipes frequently fail to prevent priming, and the cause appears to be that the united area of the perforations is too great, and priming has been stopped frequently by plugging up a number of the holes throughout the pipe. The reason in this seems to be that, with an excessive area of perforations, the steam entering the pipe would select the easiset way in, and so probably enter by a few contiguous holes near to or about the middle of the length of the pipe, *i. e.*, nearest to the valve. The rush of steam thus became similar to the rush to an open pipe, and hence the priming, whilst, when many of the superfluous holes were stopped, those left at the extremities of the pipe would come into use, and so the pipe would take steam from end to end, and no solid rush could occur to draw in water.

Experience shows that the united area of the perforations in the pipe should not exceed by more than twenty-five per cent. the area of the junction or steam outlet valve. When this area is exceeded there is liability to prime, but with this area the inlet proceeds from end to end of the pipe, and the extra twenty-five per cent. may roughly be assumed as the extra coefficient of friction due to the small perforations as compared with the single larger area of the valve.

When circumstances compel the placing of the junction valve near to the furnace end of the boiler, it is best to use a single end anti-priming pipe, extending from the valve backwards only to the quieter portion of the boiler, in order to avoid drawing steam from over water in a violent state of ebullition. The back end of the boiler is comparatively quiet, and entrained water has a chance of being deposited before reaching the outlet. The importance of perfectly dry steam, especially when intended for use by a steam engine, is too great to admit of any precaution being neglected to secure it.

On the Friction of Piston Packing Rings in Steam Cylinders.

James E. Denton presented a paper with the above title at the Scranton meeting of mechanical engineers, from which we abstract as below :

For measuring the friction, a cylinder 6" x 9" was used, fitted with a long piston, packed at each end. Between the packing was a cavity in which a third ring was arranged. This ring was not in any way connected with the piston ; that is, it was not in contact with the piston, but was forced against the surface of the cylinder, and so connected with levers and a stem passing out through a hollow rod as to make a diagram, the motion of the parts being restrained by a spring of known tension. Steam pressure was excluded from the cavity, and means taken to drain it of condensed steam. The center or friction ring was cut once, and provided with an arrangement for increasing or decreasing its tension.

With a tension on the friction ring of 65 pounds per square inch, a boiler pressure of 67 pounds, revolutions from 36 to 115, and any cut-off from $\frac{1}{10}$ to $\frac{3}{4}$ stroke, without lubrication, the co-efficient of friction was about 7½ per cent. Average good cylinder oil was then used. With a feed of one drop every two minutes (5,000 drops to a pint of oil), the co-efficient of friction was reduced to 5 per cent. With one drop per minute the co-efficient of friction was 3 per cent. The lubrication was very unsatisfactory, the film of lubricant found upon the surfaces being a sticky black paste, showing by chemical analysis about 50 per cent. of iron. With a feed of two drops per minute the co-efficient of friction was 1 per cent.

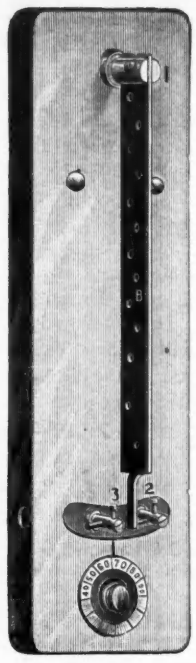


Fig. 2.

The oil upon the interior surfaces for this diagram indicated practically perfect lubrication, as it retained its natural color and was uncontaminated with iron. All of the diagrams were taken after the engine had been run at the respective feeds for about 8 hours.

Krupp is about to commence the manufacture of aluminum from Greenland cryolite, by the Netto process, by which it is said that pure aluminum can be produced at about 6s. per pound.

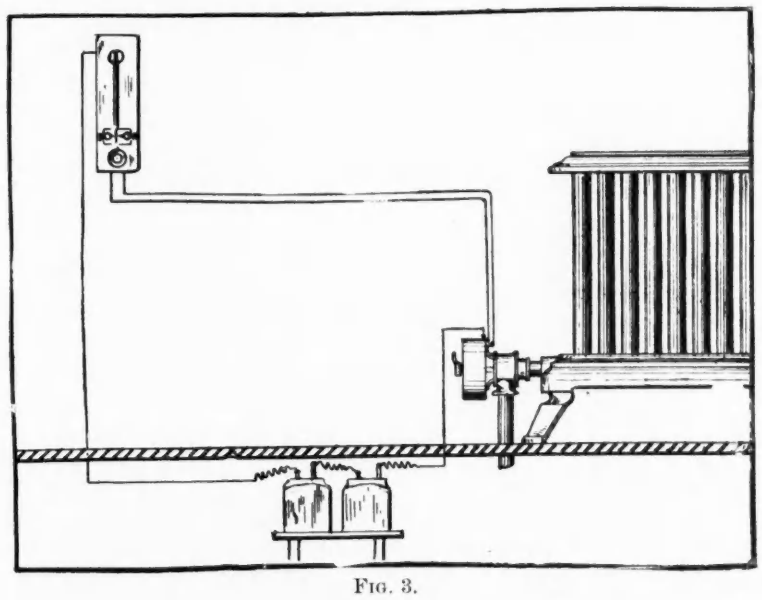
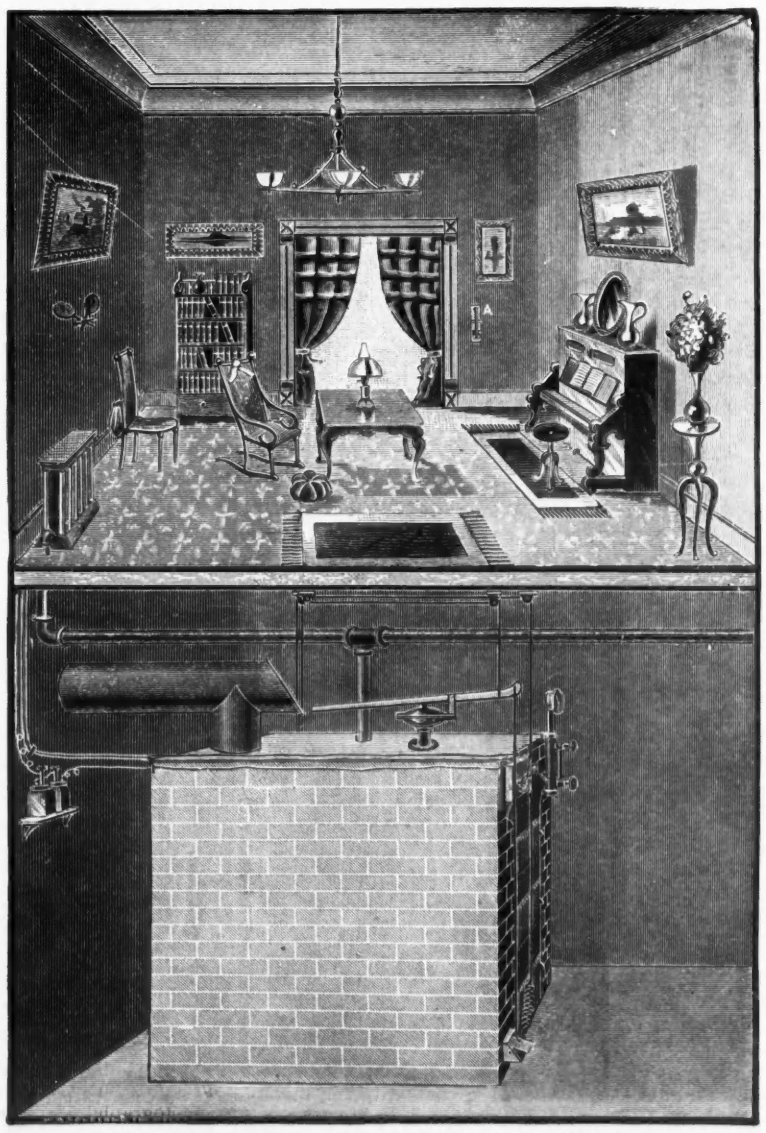


Fig. 3.



Automatic Temperature Regulator.—Fig. 1.

Automatic Temperature Regulator.

The accompanying cuts show an apparatus designed to automatically maintain a uniform temperature in a room heated by hot water or steam.

In Fig. 1 a thermostat is shown on the wall of the room at *A*. From this thermostat wires lead to a battery shown below at the side of the furnace, which in turn controls a spring motor that at one movement closes the front damper, and opens the check damper, or *vice versa*.

One form of the thermostat used is shown at Fig. 2. It consists of a nickel-plated base designed to be screwed against the wall. Upon this base are three posts, one of which is near the upper end, and has attached to it a compound bar composed of rubber and metal ; its free end being provided with a contact spring which extends between contact pins which are upon the two movable posts 3 and 2. By the expansion and contraction of this compound bar, owing to slight changes in the temperature of the room, it is deflected one way or the other, and comes in contact with one or the other of the pins, thus making the electrical connection with the battery. By means of the movable plate and the scale, the thermostat may be set to maintain any desired temperature ; the facility with which this setting may be done, enabling rooms to be kept at a temperature during the night, which, though uniform, is lower than the temperature in the daytime. A form of thermostat is also used in which this action takes place automatically at any predetermined time. For this purpose a clock is attached, having a hand which can be set at night to any desired hour, say five o'clock ; the thermostat being set for a lower temperature during the night, the clock will, at five o'clock in the morning, change the setting of the thermostat, and allow the temperature to increase to any pre-determined point.

The spring motor spoken of has a crank on the outside, to which a chain is attached, which runs to the front damper, and also one to the check damper. The crank, when the electric circuit is closed at the thermostat, makes one-half a revolution and then stops, this movement sufficing to change the condition of the dampers, according to the requirements. The motor is provided with an index, which shows when it needs rewinding, and also has a stop, that prevents winding too far. The electric circuits are each broken by the motor as soon as it starts, so that the battery force is in use for an instant only at a time.

In the application of these devices to a steam-heating system, when the temperature has fallen much below the normal point, as on very cold mornings, or when the air cocks in the radiators have been left closed, the regulator would hold the dampers open and keep the fires going at the full rate until the temperature was restored, even though steam be blowing out through the safety valve. To obviate this, there is a pressure diaphragm, which is also connected to the same dampers, so that, should the steam pressure rise above the desired point, the fire will be checked, regardless of the temperature of the rooms.

The diaphragm regulator will then keep the steam at the maximum pressure until the desired temperature of the rooms is reached, when the thermostat comes into action.

Fig. 3 shows the application of a thermostat to a radiator where steam is supplied at a fixed pressure, not under the control of the user. In this there is a small electric motor, which operates to open or close the steam valve admitting steam to the heater, which it does, according to the variation of the room's temperature from the normal one.

Of course it is needless to speak to our readers of the advantages of securing absolutely uniform temperature in a room heated by hot air or steam, as uniformity of temperature is a vital consideration, whether the health of the occupants, the success of manufacturing operations, or economy of fuel be considered, and it is evident that the system of governing directly by the temperature of the rooms to be heated is the true principle.

This apparatus is made by the Consolidated Temperature Controlling Co., Minneapolis, Minn.

Modern Locomotive Construction.

By J. G. A. Meyer.

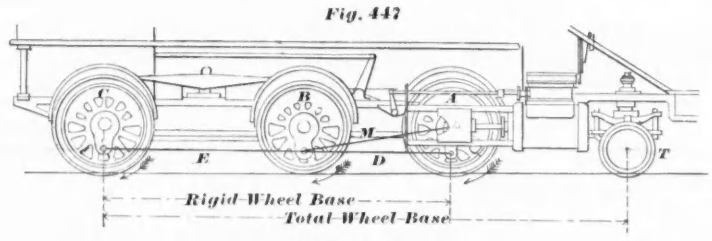
SEVENTY-SIXTH PAPER.

In nearly all eight-wheeled passenger engines, 4 feet 8½ inches gauge, the side rods are placed outside of the main rods, and therefore the brass bearings, straps, etc., at each end of the side rod, will be equal in size. In some of the narrow gauge engines we sometimes find the side rods placed inside of the main rods. In such cases the brass bearing at one end of the side rod will be larger than that at the other end of the same rod. Locomotive builders sometimes make the straps for such rods of equal thicknesses. We believe that in such cases the better practice will be to find the thickness of the strap at the small end of the rod by Rule 55, and then increase the thickness of the strap at the large end of the side rod ten per cent., provided the widths of the straps are equal, which is generally the case.

Side rod straps for mogul engines.—In mogul engines the pressure on the side rods will—as in eight-wheeled passenger engines—depend on the steam pressure on the piston, the condition of the road bed, and the condition of the engine, as we have explained in connection with side rods for passenger engines. But in mogul engines we have two other elements—not found in passenger engines—which are detrimental to the strength of the side rod strap, namely, a larger number of driving wheels, and the knuckle joint, that is, the connection of the two side rods as shown at *S* in Fig. 438.

Fig. 447 represents the wheel base of a mogul engine; the main and side rods are indicated simply by their center lines. In this class of engines the main pair of driving wheels *B* is placed between the front pair *A* and the rear pair *C*, but is not placed centrally between them. The rigid wheel base will often depend on the length of the boiler; and the distance between the wheels will in many cases depend on the general design of the boiler and the valve gear. Although these driving wheels are not placed at equal distances apart, the arrangement of the equalizing levers is such as to throw as nearly as possible the same amount of weight on each driver. For the purpose of designing the side rod straps we may assume that an equal amount of weight is placed on each driver. In order to simplify the rule for finding the thickness of the strap, we shall again assume, as we did in the case of passenger engines, that the whole steam pressure on the piston is utilized for the purpose of giving motion to the wheels. Now, since three drivers are connected on each side of the engine, and since the same amount of weight is assumed to be placed on each driver, it follows that one-third of the total steam pressure on one piston will, according to our assumption, be required to turn one driving wheel. When the driving wheels are turning in the direction as indicated by the arrows, and the crank-pins are below the centers of the axles, the front side rod *D* will be subjected, besides the transverse forces acting upon the rods, to a tensile force; and the rear side rod *E* will be subjected to a compressive force, each equal to one third of the pressure on the piston, provided the engine is running over a straight and perfect level road. On the other hand, when the crank-pins are above the center of axle, the front side rod will be subjected, besides the transverse forces acting upon the rods, to a compressive force and the rear side rod to a tensile force, each again equal to one-third of the pressure on the piston. The exact magnitude of the transverse forces acting on the side rods under the various conditions of the road bed, etc., cannot be determined, but the total steam pressure on the piston is known; we therefore assume, as in the case of passenger engines, that the side rods are simply subjected to a tensile force due to the pressure on the piston; design the straps accordingly, and make allowances for the other forces, as will be hereafter explained. If now we had no transverse forces acting on the straps to contend with, we would simply divide one-third of the maximum piston pressure by 10,000 pounds (which is about a fair allowance for stress per square inch when we have to provide against a simple tensile force), and thereby obtain the number of square inches in the cross-sectional area through the weakest part of the strap. But since we have to provide against the transverse forces, we must divide one-third of the maximum steam pressure on the piston by a number less than 10,000, and shall adopt, as before, 4,200. Hence, if we divide one-third of the maximum steam pressure on the piston by 4,200, we shall obtain the number of square inches in the cross-sectional area through the weakest part of the strap. Dividing this area by the width of the strap minus the diameter of the bolts through it, and again dividing the quotient thus obtained by 2, we obtain a thickness for the side rod straps which we shall indicate by the letter *A*. But this thickness *A* will not be sufficiently great, for the following reasons: In adopting the number 4,200, or, in other words, allowing one square inch for every 4,200 pounds of the pressure on the rod due to one-third of the maximum piston pressure, we provide against the transverse forces acting on the rod, and also for the extra tensile forces due to the condition of the road bed and condition of the engine, such as will occur in passenger engines. This extra tensile force, due to the condition of the road bed, etc., will be greater in mogul engines, on account of the increased number of wheels, than in passenger engines; and besides this we have the knuckle joint to contend with. We therefore add to the thickness *A* previously found, $\frac{3}{16}$ of an inch for the rear and front strap, and add $\frac{3}{8}$ of an inch for the central strap, for all mogul locomotives having cylinders 13 inches diameter and upwards. For mogul engines having

Fig. 447



MOGUL ENGINE

cylinders whose diameters are less than 13 inches, add $\frac{1}{4}$ of an inch to the thickness *A* for the front and rear straps, and $\frac{7}{16}$ of an inch to the thickness for the central strap. These rules can be stated in a simpler manner, as follows:

Rule 56. To find the thickness *g* (Fig. 421) for the side rod straps around the front and rear crank pins in mogul engines having cylinders 13 inches diameter and upwards: Divide the total maximum steam pressure on one piston by 25,200; divide the quotient thus obtained by the width of the strap from which the diameter of the bolts through it has been deducted, and add $\frac{3}{16}$ of an inch to the last quotient; the sum will be the required thickness.

For mogul engines having cylinders less than 13 inches in diameter, divide the total maximum steam pressure on the piston by 25,200; divide the quotient thus obtained by the width of the strap from which the diameter of the bolts through it has been deducted, and add $\frac{1}{4}$ of an inch to the last quotient; the sum will be the required thickness *g* for the side rod strap around the front and rear crank-pin.

Rule 57. To find the thickness *g* for the side rod strap around the main crank-pin in mogul engines having cylinders 13 inches diameter and upwards: Divide the total maximum steam pressure on the piston by 25,200; divide the quotient thus obtained by the width of the strap from which the diameter of the bolts through it has been deducted, and add $\frac{3}{8}$ of an inch to the last quotient; the sum will be the required thickness.

For mogul engines having cylinders less than 13 inches diameter, divide the total maximum steam pressure on the piston by 25,200; divide the quotient thus obtained by the width of the strap from which the diameter of the bolts through it has been deducted, and add $\frac{7}{16}$ of an inch to the last quotient; the sum will be the thickness *g* for the central side rod strap.

Example 91. Find the thickness *g* (Fig. 421) for the side rod straps for a mogul engine whose cylinders are 18 inches diameter; maximum steam pressure on the piston 120 pounds per square inch; width of front and rear straps 2¼ inches; diameters of the bolts through these straps $\frac{15}{16}$ inch; width of central strap 2½ inches; diameters of bolts through the same, $1\frac{1}{16}$ inch.

Let us first find the thickness for the front and rear straps. The total maximum steam pressure on the piston is found by multiplying the area of the piston in square inches by the steam pressure per square inch; hence we have:

$$254.47 \times 120 = 30{,}536.40 \text{ pounds.}$$

$$\frac{30{,}536.40}{25{,}200} = 1.211.$$

Subtracting the diameter of a side rod bolt from the width of the strap, we obtain

$$2.25 - .9375 = 1.3125 \text{ inches,}$$

and

$$\frac{1.211}{1.3125} = .922, \text{ say } \tfrac{15}{16} \text{ of an inch,}$$

which is the thickness *A*, to which $\frac{3}{16}$ of an inch must be added. Hence $\frac{15}{16} + \frac{3}{16} = 1\frac{1}{8}$ inch, which is the thickness *g* of the front and rear side rod straps.

To find the thickness *g* of the central side rod strap we divide, as before, the total maximum steam pressure on the piston by 25,200, and obtain 1.211. This quotient we divide by width of the central strap minus the diameter of the bolt. We have

$$\frac{1.211}{2.5 - 1.06} = .84, \text{ say } \tfrac{7}{8} \text{ of an inch,}$$

which is the thickness *A*. To this we must add $\frac{3}{8}$ of an inch; the sum $\frac{7}{8} + \frac{3}{8} = 1\frac{1}{4}$ inch is the thickness *g* of the central side rod strap.

Example 92. What should be the thickness of the side rod straps for a mogul engine whose cylinders are 11 inches diameter; rear and front straps $1\frac{3}{4}$ inch wide; bolts $\frac{3}{4}$ of an inch diameter; central side rod strap 2 inches wide; bolts $\frac{3}{4}$ of an inch diameter; maximum steam pressure on the piston 120 pounds per square inch? Total maximum steam pressure on the piston will be equal to

$$95.03 \times 120 = 11{,}403.60 \text{ pounds,}$$

and

$$\frac{11{,}403.60}{25{,}200} = .452$$

To find the thickness *g* for the front and rear strap, we have first .452 divided by the width of the straps minus the diameter of the bolts equal to

$$\frac{.452}{1.75 - .75} = .452, \text{ say } \tfrac{1}{2} \text{ inch,}$$

which is the thickness *A*. To this we must, according to rule, add $\frac{1}{4}$ of an inch. We therefore obtain $\frac{1}{2} + \frac{1}{4} = \frac{3}{4}$ inch for the thickness *g* for the front and rear side rod straps.

For the thickness *g* of the central side rod straps we have

$$\frac{11{,}403.60}{25{,}200} = .452$$

and

$$\frac{.452}{2 - .75} = .361, \text{ say } \tfrac{3}{8} \text{ inch,}$$

which is the thickness *A*. To this we must add $\frac{7}{16}$ inch. Therefore $\frac{3}{8} + \frac{7}{16} = \frac{13}{16}$ inch, which is the thickness *g* for the central side rod strap.

For all mogul engines in which the maximum steam pressure on the piston is 120 pounds per square inch, we believe it is good practice not to make the thickness *g* of any side rod strap less than $\frac{3}{4}$ of an inch. If our calculations, according to the foregoing rules, call for a thickness less than $\frac{3}{4}$ of an inch, then the results of our calculations indicate that the width of the strap is excessive, and should be reduced.

A Locomotive Mascot.

An engineer on the Wabash railway, whose run is between Danville and Springfield, has a cat which he would not part with for love or money. It belonged to his wife, who is now dead, and for a year past it has been his constant companion in the cab. Ordinarily it sits perched up in the cab window before its master, but occasionally it strolls out to the pilot, where it will ride for hours at a stretch, winking knowingly at the dogs which bark at the train as it thunders by the crossroads. Sometimes, when the train is approaching a station, the adventurous animal climbs to the top of the sandbox and calmly roosts there, undeterred by the shriek of the whistle or the clang of the bell. The engine has had good luck ever since the animal became an occupant of the cab, and the trainmen look upon it as a mascot.—*Pittsburgh Gazette.*

The October number of the *National Car and Locomotive Builder* contains the first of a series of articles on railway car construction, by William Voss, of Cedar Rapids, Ia. Mr. Voss is a veteran car builder, and holds the position of assistant master mechanic of the Burlington, Cedar Rapids & Northern Railway, being in charge of the car shops at Cedar Rapids. He writes in a clear and concise style, and is evidently master of the subject. We have no doubt he will interest those who follow him.

A System of Worm Gearing of Diametral Pitch.

By S. W. Powel and W. L. Cheney, Hartford, Conn.

A PAPER PRESENTED AT THE SCRANTON MEETING OF MECHANICAL ENGINEERS.

The advantages of the diametral pitch for gearing have long been recognized by engineers in this country, as may be seen in the very general use of this method of making spur and bevel gears by our leading tool makers and machine manufacturers. This fact calls our attention to the desirability of gaining corresponding advantages for worm gears by applying the diametral system to them.

It is quite likely that the principal reason for retaining the circumferential pitch for worm gearing is that ordinary lathes are arranged for cutting a certain number of threads per inch, which, in the case of a worm, calls for a certain number of teeth per inch of circumference of the worm gear, or, in other words, a gear of circular pitch; whereas, if a worm gear of diametral pitch were to be used, it would be necessary to have the lathe cut a certain number of threads per π inches, in order that the worm and gear might correspond. We will endeavor to show farther on how closely we can approximate to this requirement.

There is confusion generally in the shops which use both circumferential and diametral pitches for spur and bevel gearing, as many do where patterns are on hand for gears with cast teeth of circumferential pitch, and where cut gearing is made of diametral pitch. This confusion causes an unnecessary waste of time, and often consigns a good casting to the scrap heap; it could be avoided, so far as spur and bevel gears are concerned, by making all such gears of diametral pitch, and all confusion might be avoided by making worm gearing also of diametral pitch.

Just here we would like to call attention to the nomenclature in regard to pitch which prevails to a great extent in our New England shops, and probably to a less extent in other parts of the country. We say "three pitch," "four pitch," "five pitch," etc., where others say three per inch, four per inch, five per inch, etc. If the qualifying words per inch are applied to diametrally divided gears only, and the word pitch is used in its correct sense, and applied exclusively in the case of gears to those of circumferential pitch, the confusion would no doubt be lessened where both systems are used. In this paper we will use the expression diametral pitch as referring to that part of the diameter of a gear required

for one tooth, measured in inches or fractions of an inch; *i. e.*, the reciprocal of the number of teeth per inch of diameter.

It is not our intention to go into the theory of gearing any further than to call attention to the fact that our leading constructors of machinery who use the circumferential pitch use various proportions for the length of tooth, as well as different approximations to the two general shapes for the working surface, *i. e.*, involute and epicycloid, and also different amounts of clearance. This is to a less extent true for the diametral pitch, as the makers of cutters for involute and epicycloidal teeth of the smaller pitches generally make the length of tooth equal to twice the diametral pitch plus the clearance, which is usually one-eighth of the diametral pitch, and allow no side clearance or backlash.

In applying the diametral system to worm gearing we are confronted with probably more variations in the proportions of teeth now in use than are found in the other kinds of gearing, and some of these shapes are, no doubt, the result of expensive experiments.

What we propose is to cut the worm thread to a fractional pitch corresponding to one of the diametral pitches now in common use; make the tooth the same length in worm gearing as is now used in spur gearing of diametral pitch, and make no change as to clearance on the top and bottom of the thread, if there is any allowed. Our opinion is that in general there should be some clearance, but no backlash.

As to the length of tooth, we are aware that many machine tool makers now use a tooth proportional in length to that of diametrally divided spur gears. For those who have other proportions in use we advise a change in length of tooth as preferable to a change in the angle of the thread, and in those cases where experimental data are the basis of the shape of worm thread, we think this change would be the least noticeable of the two.

We propose to thread the worms by means of a pair of transforming gears put into the train of change gears of any ordinary lathe. We know that many small and medium-sized lathes are made with the change gears in line, and here some provision would have to be made for compounding. This can be done in a great number of cases with very little expense by making the larger of the transforming gears "dished," or with the rim offset outwards, and also making a new intermediate stud long enough to take the smaller of the transforming gears, together with the gear which would be put on the spindle in ordinary screw cutting. In this arrangement the larger transforming gear would be put on the spindle. Other arrangements will readily suggest themselves.

As to the accuracy of threads cut by the proposed method; if we use the ratio of 22 to 7 for our transforming gears, the difference between the thread cut and the theoretical pitch required will be less than five one-thousandths (0.″005) of an inch in one foot, neglecting errors of expansion and inaccuracies of the lead screw. Thus we see that the thread we get differs from the theoretical thread by an amount less than the errors of usual good workmanship; indeed, it is less than the variation between ordinary lead screws.

Now as to the method of using the transforming gears. If we make the larger gear of the two dished as previously suggested, and mark it plainly, "spindle gear for worms," make the smaller gear to go on the outside of the compound intermediate stud, and mark it "meshes into spindle gear for worms," or make and mark both of the transforming gears in some unmistakable way, the latheman will be able to cut a worm to suit any diametrally divided worm gear by using the transforming gears in the places where they are marked to go, together with the change gears required for cutting a screw having the same number of threads per inch of length as the required worm gear has teeth per inch of diameter.

To illustrate, suppose we want to cut a worm for a gear of four teeth per inch of diameter, "four pitch," or one-quarter inch diametral pitch, whichever you choose to call it, and the index for four threads per inch, on the lathe we are to use, calls for 84 on stud with 28 on the screw. We put the 28 on the screw, the 84 on the inside of the compound intermediate, the two translating gears in the places for which they are marked, and go ahead.

Our thread will be practically 0.7857142 inches pitch, whereas theoretically we should get 0.7853982 inches pitch. The difference between these pitches, multiplied by the number of times the theoretical pitch is contained in 12 inches, it will be seen is a little less than 0.005 of an inch.

Some of the advantages which we would gain by adopting this system for worm gearing are, doing away with the odd sixty-fourths and thousandths in the diameters of worm gears, and making their diameters come in even fractions; getting even figures in center distances between worm gear shaft and worm shaft or their bearings; doing away with considerable work in calculations in the drawing room, in which there is always a chance for errors; and if, in addition to using the diametral pitch and length of tooth, we make the worm gears straight across the face, which in most cases seems to us to be practically as good as the more expensive way of making the points of the gear teeth follow the shape of the bottom of the worm threads, the latheman need not know whether the blank he was turning was to be a spur or worm gear. However we would suggest that the corners of the faces of worm gears be slightly rounded, so as to show the man who cuts the gears which are to be spurs and which to be cut for worms.

Having shown the possibility of applying the same diametral system to worm, as is now in use for spur and bevel gearing, it remains for some of our gear makers to give us a practical example of this application.

Special Emery Wheels.

On this page we show sections of some special shapes of emery wheels, made with special reference to use on the Brown & Sharpe grinding machinery, by the Norton Emery Wheel Co., Worcester, Mass. The makers state that their experience has shown that soft wheels are most economical and satisfactory for this kind of grinding, and such wheels are furnished unless otherwise ordered. The various machines for which the wheels are intended are indicated, and the particular uses to which they are adapted will readily suggest themselves to those using these machines.

The cuts are reduced in size, the actual dimensions being as follows:

29	7	x	1/4	3	15	6	x	3/8	3/4	20	1 1/2	x	1/2	1/4
33	7	x	1/2	3	32	7	x	1/4	3/4	21	1 1/4	x	1/4	1/4
7	12	x	1/2	5	26	6	x	1/4	3/4	22	1	x	1/4	1/4
6	12	x	1/2	5	35	4 1/2	x	3/8	3/4	23	3/4	x	1/4	1/4
11	7	x	3/8	3/4	18	2 1/2	x	3/8	3/4	24	3/4	x	1/4	1/4
10	7	x	1/2	3/4	19	2	x	3/8	3/4	25	5/8	x	1/4	1/4

We are informed by circular from Secretary Sinclair, of the American Railway Master Mechanics' Association, that his address will hereafter be Morse Building, 140 Nassau street, New York. President Setchel's address will be, hereafter, Cuba, N. Y.

Special Emery Wheels.

LETTERS FROM PRACTICAL MEN.

Saving Drawing-Room Expenses.

Editor American Machinist:

An article which appeared in the American Machinist of October 6, entitled "How to Reduce Drawing-Room Expenses," is such an apt illustration of wrong methods as to furnish a text for this article.

If the drawing shown in "sheet one" be really the "professor's method," then that method is in as much need of reform as the civil service. Bad as it is, it is much better than that of "sheet two" or "sheet three," when used as an original drawing. The objection to this (sheet one) as a working drawing is not that it has too many dimensions (in reality it has too few), but that the same dimensions are repeated needlessly. Thus the dimension $5\frac{1}{4}''$ to the center of a boss appears four times in three views; the other dimension, $15\frac{7}{8}''$, for this same center, appears three times in the same views, while its position in the length of the piece is not given at all. This same quantity $5\frac{1}{4}''$ appears sixteen times in the drawing, ten of which are senseless repetitions. There are numberless other useless and confusing repetitions and omissions, which show one of two things: either the draftsman did not know how to put on dimensions, or he purposely distorted them for effect.*

The real fault with the article is that it teaches the principle of shirking responsibility and work, of "getting rid of lots of work by giving it to other fellows to do," and of "unloading on the man in charge of the pattern room, and that other mechanic in the machine room."

The draftsman is employed not only to "think up new designs and schemes," but to determine definitely and distinctly what the sizes and proportions of these designs are to be. If these are to be left to the whims and ideas of a score or more of different pattern makers, then the so-called draftsman is not a draftsman at all, but a schemer, who may as well shut up the drawing office and make his sketches on a board with a piece of chalk. A draftsman is supposed to have a definite reason for each size, shape or curve that he puts on a drawing, and that reason should be sufficient for his wanting it just that way and no other; but if he makes them a certain way because he has to make them some way, and does not know what is best, then he does a wise thing to leave it to some one else, and the employer would do a wise thing to get some one who can definitely determine these.

While the saving of drawing-room expenses is a consummation devoutly to be wished for, it is not the primary object in employing a draftsman. He is employed to so determine sizes, shapes and proportions of things as to reduce shop expenses, bring pieces and machines to some definite standard, and relieve (not unload on) the foremen of certain kinds of responsibility, that they may be more efficient in their work.

It is claimed, in a sort of an indefinite manner, that this half-made plan of finishing drawings saves drawing-room expenses, though how many draftsmen's services were saved is not stated. An illustration of this saving is made, however, in the drawing of a gear blank. The writer of this has made hundreds of these, of all sizes and shapes, for different machines, and the average time taken was not fifteen hours, nor one hour, but about ten or fifteen minutes. All dimensions were given, too, and it did not "upset the pattern maker," at least he never said anything about being upset, and there has been 100 or more of him.

The central idea of the whole article seems to be that the time saved by omitting to give dimensions is so great as to make a material saving in drawing-room expenses. My own experience is the direct contrary to this, and so important as time savers are marked dimensions, that I have found it to advantage to make the dimensions on pencil drawings while designing a new machine, to save the time required to measure it. If this is true of drawings directly and continually under the eye of the draftsman, how much more is it true of those made months before, but which have to be referred to when some new design comes up. Every drawing varies in size by handling and atmospheric changes,

* Our correspondent here criticises the drawings on the score of their small size and many figures. As the reduction in size was made by the engraver and not by the draftsman, we omit this criticism, as not pertinent.

and when drawings are made to scale. what assurance has the draftsman that the measurement he wastes so much time to get on the old drawing, corresponds with the piece as actually made, when that piece was made by nobody knows what pattern maker, from distorted or torn blue print, measured with a greasy 2-foot rule?

There is another serious objection to the system of measuring drawings, and that is, it compels every drawing to be made accurately to scale. In case it is found, after a drawing is made, that a certain dimension is $\frac{1}{4}''$ more or less from what it is finally decided to have it, the only recourse is to make a new drawing, while if the system of dimensions by figures be used, it is simply necessary to change a figure and the whole thing is done, and no one is the wiser, not even the draftsman himself, after he has once forgotten he has made it.

The writer of this has had a little experience in the saving of drawing-room expenses, but not by the method being criticised, and he doubts very much if that method would make any better showing. To show what has been done, a comparison will be made between two successive years in the existence of a certain drawing-room. During the first of these years the average number of draftsmen was fourteen, and during the second year three, including the "blue print kid"; yet during the second year everything went smoother, and there were not one-tenth of the mistakes that appeared during the first. It is true, not so many sheets or miles of drawings were made, but more were made that stood the test of time, and of those in actual use at the end of the second year, more than one-half were made during that year. The saving in drawing-room expenses was the salary of eleven men out of fourteen, besides the extra saving in material. The saving in other parts of the shop is an ununknown quantity, but was certainly many times that of the drawing-room.

Is it asked what system was employed? Only one—being master of the situation, and seeing that every drawing was right, and had every dimension marked on it before it left the drawing-room. There were from 15 to 20 pattern makers and from 100 to 200 machinists, not one of whom did a stroke of work unless he had the drawing and the figures for it. Any infraction of this rule was cause for instant dismissal. The drawings produced by these three not only kept all these men at work, but covered work made in other shops, and the erection of machinery in all parts of the United States.

The foremen seldom visited the drawing-room, except to procure drawings, none of which went out without due authority, and marked for the particular job for which they were to be used. The responsibility was heavy, but it was not shirked or unloaded on anyone else. Mistakes rarely happened, but when one did, a comparison between the drawing and the work instantly located its origin, and prevented its repetition. A mistake caused by failure to follow the drawing was reason enough to send a man to the office for his pay, but a mistake caused by a wrong figure of the draftsman did not cause him to be cashiered, because it was recognized that he had thousands to determine every day, and, while he was doing his best, perfection did not lurk in that drawing-room any more than in any other, though every effort was made in that direction.

The result of this system was that the exact dimensions for any piece or part, rough or finished, could be told almost instantly from the drawing office, without asking any questions of the foremen or disturbing anybody's equanimity. It also lifted from five foremen, a superintendent and an assistant superintendent, countless small worries and bothers, and left them in a position to be much more efficient.

Before closing there is a word to say in regard to the "instructions," and their inconsistency with the article in which they appear. To quote from the article, it says: "In the first place, I have always given the pattern maker and the man who bossed the shop credit for knowing as much about their branch of the work as I was supposed to know about my own"; and further along, "Bearing in mind constantly that our coworkers in the pattern-room and the shop must be credited with better knowledge of their business than any one else, and all appearances of dictation on our part must be avoided." It would be interesting to know the workings of the boss pattern maker's mind when he reads this, and sees it followed by instructions to pattern makers, which begin by saying, "Measure and make allowance for shrinkage and draft," or to see the foreman of the machine shop's face when he receives from the draftsman printed instructions which tells him that "a hole marked 'tap,' is to have a thread in it." Most people familiar with shop practice have generally supposed that pattern makers and machinists did not need instruction on these points from the draftsman, especially when they are given credit for knowing more about their business than he does.

My own experience is that a "code" is a nuisance. I have run across several, but have never used any except the general one, that "That drawing means just what it says, no more and no less, make it your own way but give me those results."

There are a good many good points in these "instructions," but they should be from the superintendent to the foremen, and not from the draftsman to the workman. It is none of the draftsman's business how the individual workman does his work; the business of both is with the foreman, and not with each other, except by the permission or wish of the foreman.

There certainly are situations where such a "code of instructions" and system of drawing are of great advantage in the production of work approaching uniformity, but it is in that transition stage between no system and some system, where the instructor occupies the triple position of superintendent, foreman and draftsman, and is so overloaded that he cannot get through in any other manner. In such a case as this it is necessary for the man in charge to make use of the best material he can get to help carry the responsibility, and where this material is poor, a code of this kind, when accompanied by the proper personnel, will do much toward coaching it up. But in the modern large shop, with subdivision of work and specialists in charge of each department, such a system of drawing should find no place, and the draftsman who will try to shirk his responsibility by shifting it on somebody else should be given some other job. C. L. Redfield.

Fitting Wrist Pins.

Editor American Machinist:

In the American Machinist of Sept. 29th, in an article entitled "Shop Notes," is a description of a special appliance to a boring mill to bore the wrist pin hole in an engine crank without removing from the position it was fastened in while boring the shaft hole.

This suggests some thoughts and criticisms on current methods of constructing engine crank-shafts. The appliance mentioned will, no doubt, save time in making a crank, and incidentally, the hole for wrist pin may be more likely to be bored parallel to shaft hole, but even when such accuracy has been secured, it is far from accomplishing what is really necessary to a correctly constructed crank-shaft, viz., parallelism of wrist pin with shaft. Mechanics experienced in such constructions know that there is no method of putting a crank on a shaft, securely enough to remain, that will also insure that the wrist pin hole will be parallel with the shaft.

The best that can be done in putting on the crank, is to force it on by hydraulic pressure, being very careful to hold the crank squarely with the shaft during the entire operation, and then put in a key which fits securely at the sides, and touches but slightly, if any, at the top and bottom. Even with these precautions strictly enforced, it will be found, by properly testing, few, if any of the wrist pin holes will be parallel with the shaft, although they may have been parallel with the shaft hole in crank. The cause is that, in order to make the crank secure, it must be put on so tight that it necessarily distorts the material of which it is made, and produces the results stated above.

It would seem from the foregoing that, if a firm thinks it necessary to procure some special appliance for boring wrist pin holes, that it would be much better to invest the money in an appliance for doing so after the crank has been secured on the shaft, thus doing away entirely with one prolific source of error.

In constructing a disk crank, after it is secured to the shaft, it should be faced square with the shaft, and then the appliance could be fastened to this face, and the wrist hole simply bored square with the face. If it were an arm crank, alignment of the boring machine could be secured by Vs on the base of it, resting on the shaft and fastened to it.

Of course some shops could not afford to have such a machine, and yet might desire to make accurate cranks. To such, the plan adopted by Mr. Harris Tabor some years ago is a good one. In this plan the wrist pin must be a taper fit in the crank, and held in by a nut or key. The wrist hole is bored in the usual way, and the pin fitted to it with some allowance for grinding in with grain emery by hand. After the engine is placed on and secured to foundation, and the shaft is in position and leveled, take half of the crank wrist box out of the connecting rod and place it on the wrist with butt side up, the wrist being in its hole in the crank. Take a level that is accurate enough to detect easily an inclination of one-thousandth of an inch in a length of two feet, and level the flange of the wrist box at right angle to the wrist, at the same time having the wrist vertically above the center of shaft; then place the level across the flanges of the box about parallel with the wrist; here the bubble should approach the center, and if it does not, then one of the box flanges must be filed down until it will.

Note the position of the bulb at this point, then turn the crank a quarter of a revolution, and repeat the leveling; do this at all four quarters, and by that time you can tell which direction the wrist is out. Place the crank in a position that the weight of the wrist would tend to bring it in line, and proceed to grind in the wrist with emery and oil. By doing all this carefully, and repeating the leveling occasionally to test your work, the wrist pin may be brought so perfectly in line that no error can be detected with the level. It must be remembered, however, that this can only be accomplished by a mechanic skilled in the different processes, and who thoroughly understands what a thousandth of an inch means. B. Crank.

Measuring Screws.

Editor American Machinist:

In making screws it is very essential not to make over size in any part of the thread, or the screw would not enter the hole tapped to receive it. Now in measuring screws with ball points, if the angle is not correct, which often happens, from the wearing of dies or the imperfect grinding of threading tools, the screw would measure over size either at the top or bottom, when the ball point calipering might read, compared with standard, all right, as mentioned in your previous paper, but the screw would not enter the hole tapped for same if the angle was off. Now in using the nibs described by Jarno, the screw could not be over size without being detected; as by using the smallest and largest nibs applicable to screw to be measured, the calipering should read alike with both nibs. Furthermore, by holding the caliper to the light, with screw between the nibs, the error of angle can be detected if too obtuse or acute. This method will readily be seen by mechanics to be far in advance of measuring with ball points. There is one more very important element that is to be considered in connection with measuring screws, that is the correct pitch. This is best detected practically by comparing with standards such as furnished by the Pratt & Whitney Co. Much more might be said in connection with this subject, but I think I have explained the most practical method of measuring ordinary screws. This system certainly gives better results than any other I know of.

G. E. W.

In ordinary shop practice it is not customary to measure each screw produced by any such refined methods as either the "nibs" referred to, or by ball points. Such methods of gauging are used only upon taps which it is desired to make accurately to size for standard screw plugs or similar work. And on such work it is not worth while to consider such gross inaccuracies as G. E. W. refers to, because they would be inadmissible, and would of themselves render the work useless, regardless of its accurate or inaccurate gauging. A man who undertakes to do work of a grade requiring such refinement in gauging, should certainly be able to recognize the necessity for having the shape of the thread correct, and if he cannot secure this condition there is little use in his undertaking such work. The method of gauging which has now been fully shown by "Pedro" (issue of October 13), will, without doubt, enable very accurate results to be obtained by original measurement, and without comparison with any other standard. But having a standard with which to make comparisons, the ball method will enable accurate results to be obtained, *provided* the correct angle and shape of thread are secured; and this is all that was claimed for it in the first place.

Fred J. Miller.

Turning the Taper on Twist Drill Shanks.

Editor American Machinist:

I recently had occasion to use a very simple method for turning the taper on twist drill shanks, which may be of use to "C. W., Cedar Rapids, Iowa" (Query 429), Sept 29th.

The device as I used it consists of a simple driver, or hollow center, composed of equal parts of block tin and solder, about 3″ diameter, and $1\frac{1}{2}''$ thick, or any other convenient size; this piece may be revolved in the lathe by means of an ordinary lathe chuck, then turn a slight concave in the metal about the same angle as the drill point, into which the drill point is embedded, by forcing the dead center forward while the lathe is revolving; the metal being soft, the drill point enters readily (while revolving with the lathe) forming lugs on both sides of drill cutting edge, which serves to rotate the drill with the lathe. I turned about two dozen shanks (the drills ranging in size from $1\frac{1}{2}''$ to 7″, the socket having a taper of $\frac{3}{4}''$ to the foot); by using this method of driving, the dead center of course being moved forward to obtain the desired taper. M. D. F.

Mounting for Blue Prints.

Editor American Machinist:

As it is often a question in the shop how to dispose of the working drawings and blue prints, I respectfully suggest the following cheap plan of mounting them for convenience and cleanliness, and one which has proved satisfactory in the absence of anything more elaborate or expensive.

We send either blue prints or cheap pencil drawings in the shop, the latter when we expect to make only one piece of that kind.

We take the sketch or print to the circular saw scrap box and pick out a couple of convenient strips, say 1″ to $1\frac{1}{4}''$ wide × $\frac{3}{16}''$ to $\frac{1}{4}''$ thick, and as long as the blue print, tack them together with small brads, the upper edge of the print being caught in between them; two gimlet holes and a piece of heavy twine complete the job and we have a light, handy and inexpensive mounted drawing, 50 of which can be hung on a common hook if so desired, and selected as wanted. We suggest the plan as a shop kink to those who may feel disposed to make use of it.

Pencil.

The yellow fever at Jacksonville, Fla., has played havoc with business there. One of our subscribers there, T. Murphy, who does a general machine and iron and brass foundry business, writes us, in renewing his subscription, that most of his men are away, and some of them sick. But the impending cool weather will remedy this. The citizens of

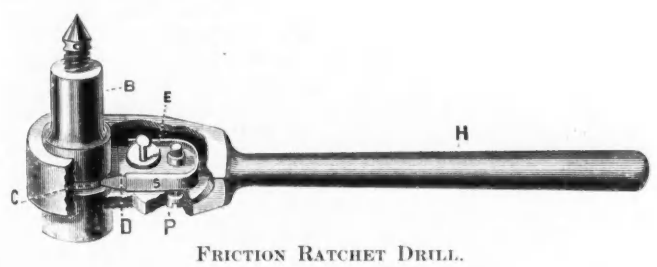
Jacksonville have shown themselves brave under their troubles, and they have had the sympathy, and substantial aid, of the whole country. This is just as it should be. Jacksonville is an enterprising southern city, and with the advent of cool weather will soon recover from the effects of the calamity with which it has been visited.

A Friction Ratchet Drill.

The engraving presented herewith shows the appearance and construction of a new ratchet drill, which, instead of having teeth in which the pawls engage, has a wedge-shaped groove turned around the body of the drill, in which pawls of corresponding shape are fitted, and so arranged that when the lever is moved one way, they slip, while if it is moved the other way they engage by friction. The U-shaped spring *S* serves to press the pawls into place and cause them to act, but either one may be thrown out of action by turning the eccentric *E* one way or the other, thus making the drill right or left hand. This change is of course readily made.

The drill is so arranged, that taper or square-shanked drills can be used if desired.

The manufacturer is Thomas C. Massey, Chicago, Ill.



Friction Ratchet Drill.

A New Elevator.

The engraving presented herewith represents an elevator just brought out by The D. Frisbie Company, 112 Liberty street, New York. The intention has been to make a machine of moderate price, without sacrificing any of the essential features.

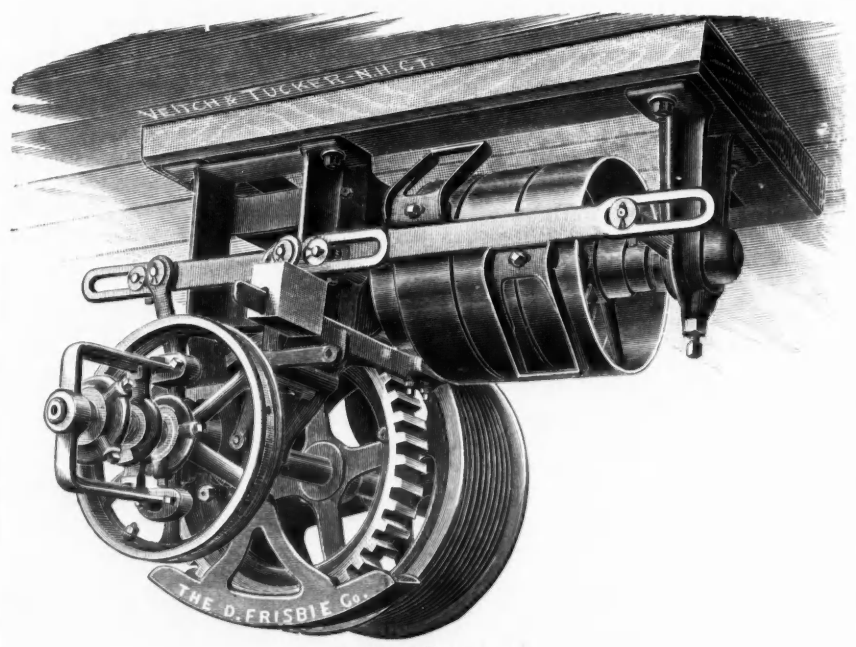
The entire machinery is contained in an iron frame, and every part is arranged with special reference to being come at easily for inspection.

A bronze worm gear, driven by a cut steel worm, is used. This worm runs top of the gear, which brings the strain where it has the least effect to spring the frame.

The thrust collars are outside the box, where they can be adjusted by means of a set collar, thus keeping the worm in its proper position, and the machine in smooth running condition. New collars can be put on, when needed, without removing the worm shaft. The pulleys have graphite bushings, and require no oil. There is a limit stop motion, to keep the car from going too low or too high.

The device for shifting the belts is such that the work on the starting rope is easy ; it operates in connection with the brake, automatically.

The car used with this machine has a wedge grip, worked either by counterweight or a spring. This permits the use of small guide posts, as the pressure is directly downward. One of these machines may be seen in operation at the fair of the American Institute.



A New Elevator.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

By W. H. Hoffman.

SIXTEENTH PAPER.

In laying out the plan drawing for the lower portion of all the cylinders, there will be provision made for a firm and substantial fastening of the cylinders to the main upright frames of the engines. The lower cylinder heads of the high and intermediate pressure cylinders will be of the same size, relating to diameter and depth as the upper heads of these cylinders, but the low pressure lower head will be smaller than the upper head, and will be from the same pattern as that used for the intermediate pressure cylinder; a portion of the lower head being cast with the body of the cylinder.

As described in a former paper, the steam chests for the piston valves will be located in the spaces between the cylinders, and therefore there will be ample room on the sides of all the cylinders' bodies, in both tranverse and fore-and-aft directions, for the provisions for the frame fastenings mentioned in the beginning of this paper.

Attention is particularly called to this matter, for the reason that sometimes the excuse for infirm cylinder and frame fastenings is that the large, overhanging steam chests will not admit of a thorough connection of these two important details.

In our arrangement, the heavy projecting flanges that are cast to the bodies of the cylinders, and that rest on the top of the main upright frames, will be free and clear of all three of the steam chests, and will have two bracket-ribs running from the faced flanges, well up on the bodies of the cylinders. These flanges will all be $2\frac{7}{8}''$ thick, and each flange will have two bracket-ribs $2\frac{1}{2}''$ thick. Above these flanges will project the hubs for the cylinder holding down bolts. The hubs will be faced off on the top sides true with the bottom faces of the projecting flanges, and will have a locking slot $\frac{7}{16}''$ wide, and $1\frac{1}{4}''$ deep, milled across the top, through which will be driven a safety key, to prevent the bolt from starting loose when the engines are running at continuous high speeds, and also to hold the bolts from turning when screwing up the nuts.

We have, at this time, described the main fastening of the cylinders to the upper portion of the upright frames, in order to show that, at all times, both the starboard and port side fastenings can be examined readily, in the regular inspection before sailing, and when the alert chief and assistant engineers are looking for loose bolts, etc., that may have developed on the inward trip. Not alone this, but it will be seen by the reader that the usual complicated assembling of stuffing boxes, valve stem guides, rock shafts, and levers, are not, in our design, found in too close proximity to the main cylinder fastenings.

With a design like this it will be seen that the repairing of the lower cylinder heads, and the main guides and crossheads, can be carried on without the usual obstructions to the workmen, and this one item is of great importance in the design of the high-speed vertical marine engine.

While we are at this point in the design description, I will complete my remarks on the lower cylinder heads, and will describe the arrangement of the lower stuffing boxes, together with the method of operating them. As previously stated, the high pressure and intermediate pressure cylinder heads will be made the same diameter, as to flanges and counterbore fit, as the upper heads. One pattern will be used in casting the upper and lower heads on each of these respective cylinders, the only difference being in the sizes of the stuffing boxes for the main portion of the piston rods, and the tail end portion of these rods, and also in the arrangement of water-collecting wells or pockets in all of the lower cylinder heads.

There will be no water pockets in the upper heads, but simply three snifting valve connections for each head. The changes necessary are made by simply altering the core-boxes, but all outward surfaces of the pattern will remain the same for the upper and lower heads. The water pockets in the bottom of all the cylinder heads will be radial, and six in number. They will be cylindrical in form, $1\frac{3}{8}''$ in diameter, and will be connected to the inner upper surface of the heads by slots $\frac{1}{4}''$ wide, running from the outside of the stuffing box to within $1\frac{1}{4}''$ of the counterbore. These six radial pockets will be connected by a common channel, cast immediately at the outside surfaces of the stuffing boxes, and this common central passage will be connected to the snifting valves, and the pipes leading to the hot water pumps for returning the water from condensation to the main boilers.

The lower stuffing boxes will have an inside diameter of $7\frac{3}{8}''$, and an allowance of $7\frac{1}{2}''$ in depth for the reception of metallic packing. From the lower side of the metallic packing to the outside end of the stuffing boxes there will be a distance of $3\frac{1}{2}''$, thus allowing for a gland of that depth. The ends of the stuffing boxes will project 6" below the flat surfaces of the cylinder heads, and will have a square thread, three threads per inch, cut the entire length of the 6" projection. On this thread will be fitted the gland pressing sleeve, made of bronze, and finished all over. On the outside surface of this sleeve will be cut spiral teeth, suitable in form and pitch to run with a steel worm of 1" pitch, and of a diameter of 4"

The worm shaft will extend to the outside of the upright frames, and will there be fitted with a hand wheel, clamp plate, and thumb set screw. The projecting neck of the stuffing box will be tapped in three places to receive three $\frac{3}{4}''$ headed bolts, to be inserted and used only in case of any unseen mishap to the worm adjustment of the stuffing boxes, and it will therefore be understood that these screws will only be used in case of an emergency, and will be kept in the engine room stores.

The writer has tried many designs for stuffing boxes for vertical engines, but has never found any of them to give the entire satisfaction found in the use of the one just described. It is quick, steady, and sure in its action, very uniform in its distribution of its pressure, and it is always self locked, in any position. As the outward bearing is held and clamped in a trunnion bearing, the worm can be instantly swung out of gear with the sleeve should necessity require it.

The inside of all the stuffing boxes will be so constructed that if at any time the metallic packing should be injured and give out, *any* of the ordinary fibrous packings can be inserted in its place without any change whatever in the stuffing boxes, glands, and sleeves.

In relation to the principal dimensions of the cylinder heads, I shall endeavor to combine lightness and great strength. The heads will project into the cylinders $4\frac{3}{8}''$ at the outer edges of the bore, and will, of course, be curved in concave form, to suit the pistons; the whole depth at the center being 7", not counting the stuffing box neck, which, as previously stated, has a projection of 6". The thickness of flanges on the six cylinder heads will each be $2\frac{1}{8}''$, and they will have a projection all around the counterbore of $3\frac{3}{4}''$. There will be six ribs each $\frac{3}{4}''$ thick in the high pressure heads, eight ribs each $\frac{5}{8}''$ thick in the intermediate heads, and twelve ribs each $\frac{7}{8}''$ thick in the low pressure heads. The inner and outer plates of the cylinder heads will be $\frac{3}{4}''$, $\frac{5}{8}''$, and $1\frac{1}{4}''$ thick respectively, and there will be large round corners where the ribs join the plates.

Alfred B. Couch.

Alfred B. Couch, who died August 2, very suddenly, of neuralgia of the heart, was born at Great Barrington, Mass., May 17, 1829. In his sixteenth year he entered Williams College, but, owing to the death of his father, Dr. John W. Couch, he did not remain to graduate. In August, 1847, he began his apprenticeship with McKay & Hoadley, at Pittsfield, Mass. After serving his time he worked in different shops, in various States, as journeyman machinist, foreman, and draftsman.

In February, 1864, he took the position of superintendent and general manager of the New York Steam Engine Company's works, at Worcester, Mass.

In August, 1871, he accepted the position of mechanical engineer and designer for Wm. B. Bement & Son, of Philadelphia, with which firm and its successor, Bement, Miles & Co., he remained until May of the present year, when, feeling the need of rest, he took a vacation, extending to the time of his death.

Mr. Couch was well known to the mechanical world as an able engineer, and has very quietly done his share in bringing about the mechanical progress of the last quarter of a century. Modest and unassuming, he never pushed himself before the public, but his friends, and they were all who knew him, understood and appreciated his ability as an engineer no less than his sterling qualities as a man and friend. The world is always better for such men having lived in it.

Ingvold Risvold.

Ingvold Risvold, who died at Manchester, N. H., Sept. 20, aged 53 years, had been foreman at the Manchester Locomotive Works for twenty-five years. He was a mechanic of much ability, and was highly respected by everyone connected with the works. The daily press of Manchester speak in high terms of his character as a citizen.

There is every reason to believe that the iron and steel industries in Britain are reviving very materially. In some lines, manufacturers, who a few months since were begging for orders, are now behind, and apologizing for delays. It is believed by those presumably competent to judge, that the present improvement will be lasting.

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Excessive Hours of Service on Railroads.

There have been numerous instances in which serious wrecks and loss of life have resulted from working train crews an unreasonable length of time without opportunity for rest.

Not long ago we noted the occurrence of such an accident in England, which resulted in the issuing of an order limiting the number of hours of continuous service to something like a reasonable length of time. The necessity for some limitation of the kind has been again shown, by the collision of a freight and passenger train on the Metropolitan branch of the Baltimore and Ohio Railroad, and the consequent killing of three trainmen and the wounding of several others. The men in charge of the freight train state that they had orders to lie on the switch at Tuscarora and wait for two sections of the Pittsburgh express and the Cincinnati and St. Louis express to pass. After the first section of the first train passed, they, having been on duty *thirty-six hours*, went to sleep to secure a little rest. Awakening as the second section of the first train passed, they mistook it for the second train, as it was running on that train's time. They consequently pulled out onto the main track, with the result as above stated.

We repeat what in substance we have said before, viz.: that trainmen, especially engineers running on single track roads, must have every faculty in active employment continuously during a run, and to expect men to do this for thirty-six hours, without rest, is to expect impossibilities and to invite disaster. Stringent laws should be passed against the practice, far too prevalent, of requiring such unreasonable hours, and severe penalties should be inflicted for its infraction.

Journalistic Perspective.

Most of our readers, of course, have a very good idea of the meaning of the word perspective as applied to drawings of machinery and so forth. They know that drawings of machinery which are not in perspective show each and every part in its true proportion and position relatively to all the other parts, and that, no matter what view of the machine be taken, all the parts are, in that view, drawn the same size as in any other view. This is not the case in a perspective drawing, because there the relative magnitude of the different parts on the drawing must depend upon the particular point of view chosen, and the relative distance of the various parts from the observer; so that if two different perspective views of the same machine are given, supposed to be made from different standpoints, parts of the machine which in one view appear very large and prominent, may, in the other view, be scarcely perceptible, and *vice versa*. Our readers also know that while perspective views of machinery may be very desirable as pictures, they are comparatively of little use as guides to him who would construct a machine. The machinist who is to build a machine cares but little for a picture of it in perspective, but wants a drawing, showing the various parts in their true relative proportions and positions, without regard to the point from which they may be viewed, or their supposed distance from the eye.

But there is another sort of perspective to which we wish to call the attention of our readers, with which many of them are probably not so familiar, yet which it is necessary to be somewhat acquainted with in order to avoid falling into serious error, arising from a failure to take it into account in forming an estimate of things. We refer to what newspaper men call the "perspective of news," but which, since it seems to be applied to many things printed in the papers which can scarcely be classed under the head of news, would be better designated by the term journalistic perspective. The perspective of news has, by a prominent newspaper man, been explained to mean the giving to news a prominence graded nicely, according to its distance from the field which the paper publishing it occupies. Thus a fire, or a murder, occurring in the town where a paper is published, should, of course, be given more prominence in the way of head lines, large type, and extended treatment, than would be given to a similar occurrence fifty miles away; a distance of one hundred miles should reduce it still more; while a thousand miles would make the item announcing it scarcely perceptible. This, of course, is an effect due only to distance, and is a comparatively simple matter, which any one familiar with drawings will readily comprehend. But one who, having mastered the principles of perspective as applied to drawings of machinery, should conclude that therefore he could easily apply those principles to journalistic perspective, and so arrive at an understanding of it, would, if he tried it, find himself sadly mistaken, because, while the art of perspective drawing is controlled by comparatively few laws which are fixed and invariable—subject to no exceptions whatever—journalistic perspective is a much more complicated affair. Its nature will probably be easiest understood by the uninitiated, by the contemplation of a few instances of its effects.

In New York there are every day, dozens of people meeting with accidents of various kinds, which result in serious injury, and in many cases death. The sound of the hospital ambulance gongs, as they go through the streets with their burdens of mutilated humanity, is familiar. Two to four lines in the city papers usually suffice to give the public all the information they are supposed to need about these cases, and, applying the ordinary rules of perspective, it would be thought that the news of a minor accident to a young man, remarkable for nothing in particular, when happening in a city a thousand miles distant, would be chronicled in an item which had almost reached the vanishing point. But in a recent case of that kind the announcement was expanded into quite a lengthy dispatch, with prominent head-lines, and all the minute particulars were given, because the young man happened to be the son of a millionaire. Many similar instances might be cited, tending to show that the normal effect of distance may be greatly modified by other circumstances, but the most curious and interesting effects are observable when the influence of distance seems to be entirely eliminated, and the relative position or point of view is the only thing taken into consideration. And just at this time there is a very favorable opportunity to study the effects of this influence, because it is most prominent in the party organs, which, of course, have a fixed and unalterable point of view from which they look at all things, and draw pictures of them for the edification and enlightenment (?) of their readers. As in the study of mechanical drawings, so in the study of the pictures drawn by these party organs, it is of prime importance to him who would thoroughly understand them, to know and to bear constantly in mind the point of view taken by the draftsman. This ought to be easy to do, because that point of view is always fully announced and made known beforehand. For instance, take any of the political speeches now being made, and it can be known beforehand, without the shadow of a doubt, just whether any given organ will declare any given speech to contain nothing but truth and wisdom, or misrepresentation and folly. This will depend not at all upon what may be said by the speaker, but upon his position relative to that of the organ; and this is where the journalistic perspective comes in. It is this journalistic perspective which makes the bill now before Congress, for the revision of the tariff, appear to be the pink of perfection, beneficent to American manufacturers, farmers, working and business men, or, the reverse; a bill drawn solely in the interest of England, and pernicious to the last degree. It is this (we suppose) also, which causes the many accidents which there is reason to believe are constantly taking place on the "Q" railroad, to be dwarfed into utter insignificance, and be considered unworthy of notice.

It is thus seen that journalistic perspective is a very complicated science, and one which an ordinary man cannot hope to fathom, unless he accept as a key a motive which is scarcely complimentary, especially to the organs.

We sincerely hope that our friends will bear constantly in mind the existence of this peculiar perspective, and when they feel inclined to take an extreme view of matters, and to think that unless pretty much everybody else can be induced to take precisely the same view the country will certainly go to the demnition bow wows, to stop and think whether or not the view they hold is a perspective one, drawn by an organ, on the principle (?) of journalistic perspective, and not a true representation of the matter at all.

How Insurance Companies Block Progress.

Whenever it is sought to introduce, for manufacturing purposes, something new in the way of fuel, or some new device for burning gaseous or liquid fuel, the luckless inventor is reasonably certain to meet the opposition of nearly all the insurance companies in the country. And however meritorious what he has may be, he will have a hard time combating them. It is quite proper that insurance companies should examine risks carefully; every one who has property insured is interested in that. But the trouble appears to be that they do not examine carefully. They simply refuse the risk without an investigation, as being the easiest thing to do.

Insurance agents may be excellent men in their way, but they are not necessarily, nor generally, good judges of devices for burning gaseous or liquid fuels, and as men will insure their property anyway, the agents find it easier to refuse risks if a change is contemplated involving the use of something they are not familiar with. But there are experts in testing such things, and while it might not benefit the companies, it would benefit the public if the companies would oftener avail themselves of their services, letting them pass upon the safety of such devices after suitable tests, rather than obstruct the introduction of things really needed.

There is hardly anything having fire, or the possibility of fire about it, that insurance companies have not opposed, on general principles, and to a greater or less extent hindered the introduction of. If they would reform their practice in this respect it would benefit the public, and probably do the companies no harm. There is a difference between conservatism and old fogyism.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(461) S. R. C.: Will you please give the best method for figuring gearing for cutting threads on the lathe when you have no table to go by? *A.* You will find what we consider the best method in our answer to Question 15, issue of Jan. 14, 1888.

(462) W. S., Springfield, Ill., writes: Please inform me which year will complete the present century. Is it the year 1899 or the year 1900? There has been a dispute in regard to this. I claim that Dec. 31, 1900, is the last day of the present century. *A.*—You are right.

(463) J. U. A., Mot, Cal., writes: Is it practicable to raise water from a well by attaching air chambers to the suction pipe 20 feet apart, as shown in sketch? *A.*—No; you cannot raise water by suction to a height much greater than 28 feet. 2. The address you ask for is 57 Rose street New York.

(464) C. P., Philadelphia, Pa., writes: Please inform me whether any patents for a machine to obtain the pitch of a screw propeller have ever been taken out; and if so, how can I obtain particulars of the same? *A.*—We are not aware that any such patent has been taken out. Any good solicitor of patents will make a search of the patent record for you, and give you all the required information.

(465) J. P. P., Hartford, Ct., asks: Can you tell me of a cement or composition which is hard, tough, dries quick, and is a perfect insulator for electricity, which will also stand a reasonable degree of heat, say about the melting point of brass? *A.*—We do not know of a substance which will fill the above conditions, though perhaps some of our readers may be able to help you. You might possibly apply insulating material first, and then cover it with a preparation of asbestos.

(466) C. E., Farmington, N. H., asks: Please give me a receipt for removing the oil which is burnt on the finished parts of an engine. Several methods have been suggested to me, but I find them only partly successful. *A.*—It seems to us that such stains can only be removed by the use of fine emery and repolishing the stained part. Of course the oil can be removed by strong lye water, as recommended in the AMERICAN MACHINIST, March 8, 1884, page 6, but this will leave the parts which have been cleaned to some degree discolored.

(467) J. L., Toronto, Canada, asks: 1. Is it necessary, in a pair of compound Corliss condensing engines (working side by side), to have a variable cut-off on the low-pressure cylinder as well as on the high-pressure cylinder? *A.*—For good economy, yes. 2. Is it advisable to have the low-pressure cut-off under the control of the governor on the high-pressure cylinder, or simply adjustable by hand? *A.*—It is always advisable to have the cut-off valves of the high and low-pressure cylinder under the control of one governor.

(468) S. A. B., Pleasantville, Pa., asks: What is the best form of tool for re-boring tubes of brass, wrought-iron, cast-iron and steel. The tubes must be true and smooth. Sizes ¾ inch to 3 inch, length usually 5 feet; amount required to be cut out 1-32 to 3-32 inch. *A.*—It is hard to say what would be the *best* form of tool, but we should try a short boring tool similar to a reamer, the teeth being left-hand spiral; attach this to the end of a bar sufficiently long to reach through the tube, in the case of the larger sizes, and make it solid in the smaller ones.

(469) A. E. G., Ottumwa, Iowa, writes: Please state if it is the general shop practice of locomotive builders to bore cylinders and face up valve seats after the cylinders are fastened in position on engine frame. *A.*—The general practice is to bore and plane the cylinders, fit and bolt them together, and drill all other holes in them, in fact, finish the cylinders completely, before they are placed in position. In some shops, the only holes which are left to be drilled by hand, after the cylinders are placed in position, are the bolt holes through the flanges of saddles, for bolting the cylinders to the boiler; but even these holes are in some shops drilled by machine before the cylinders are placed in position.

(470) G. H. G.,———, Pa., writes: We have trouble keeping the pillow blocks of our blast engines from heating without using water in and on the bearings with the oil and grease. The total weight on pillow blocks is about 65 tons net. The brasses in pillow blocks are 30 inches long by 14 inches wide, babbitt lined. The main shaft is 18 inches diameter. The total weight of engine 220 tons, vertical type. Steam cylinder 50 inches, air cylinder 100 inches, stroke 84 inches. Speed about 25 revolutions. Bottom of steam cylinder about 14 inches above top of shaft. Cylinders not lagged. Now, please answer. 1. Are the bearings large enough? *A.*—We cannot tell, since you have not given us the steam pressure in the cylinders to enable us to obtain the total pressure on the journals. But in any case we believe the journals to be too small in diameter to prevent a spring in the same. 2. Does pure water on the pillow blocks interfere with the lubricating of the oil or grease? *A.*—No. 3. What do you consider best for lubricating such bearings? *A.*—It seems to us that the best quality of lard oil should answer your purpose, although sperm oil stands at the head of the list. 4. What do you consider best for cooling a hot bearing in case you cannot stop? *A.*—Sulphur and oil on the journal, with the application—very cautiously—of cold water externally.

(471) J. I., Cleveland, Ohio, writes: I have just arrived from England, where I was employed as an engineer. In order to obtain in this country a similar position, I find that I must first become a bookworm and prepare for an examination. Will you kindly inform me what book will be the best for me to study. *A.*—In order to compete with American workmen you must have a good common school education, such as is obtained in any of our public schools; and this, we believe, is not too much to expect of any persons, men or women, who intend to make permanent homes for themselves in this country; indeed, such an education they should have, whether they intend to compete with others or not. We would also advise you not to find fault with the existing state of things in this country, as for instance, the expression "must first become a bookworm" seems to imply. A person need not be a bookworm to obtain a position as a stationary engineer, but for running a stationary engine we do require sober, intelligent and trustworthy men, and if in this respect we are ahead of other nations, it is not our fault, but rather the fault of those who are willing to be left behind. In order to enable you to pass an examination for a stationary engineer, you must obtain a fair knowledge of arithmetic which you can obtain by studying any elementary work on the subject, of which many excellent ones are published in England as well as in this country. Besides this, you must have a fair knowledge of the steam engine, which you will obtain by studying Bourne's Catechism of the Steam Engine. If in addition to this you have a practical knowledge of running an engine, there will be nothing to prevent you from passing an examination and obtaining the desired position.

(472) J. F. S., New York, writes: I have two boilers 4 x 14 feet; each boiler has fifty-three tubes 3 inches diameter; the grate surface is 4 x 6 feet. What I want to know: Is not this grate surface too large for the amount of heating surface to obtain the highest economy in fuel? *A.*—That depends on the kind and quality of fuel used, and also on the draft of the chimney. 2. What is the proper allowance of grate surface for a boiler of the size given above? *A.*—The grate surface of a boiler is proportional to the heating surface, usually being from 1-25 to 1-35 of the latter. When no special orders are given for the size of the grate, the following sizes of grates, given in the Treatise on High Pressure Steam Boilers by W. H. Barr, are usually supplied with tubular boilers:

Diameter of boiler in inches.	Grate.	
	Width.	Length.
36	45	48
38	47	48
40	49	48
42	51	52
44	53	52
46	55	52
48	57	52
50	59	60
52	61	60
54	63	60
56	65	72
58	67	72
60	69	72

(473) R. H. C., Milwaukee, Wis., asks: 1. Is there a standard commercial valve of an indicated horse-power in any of our large cities, especially in large buildings which furnish heat and power to tenants? *A.*—There is no standard. 2. Is there a standard charge per 100 square feet of radiating surface? *A.*—There is not. 3. Will you please mention the prices charged per 100 square feet for heating and per horse-power? *A.*—The steam of the New York Steam Company is sold at a fixed rate per thousand kals (a kal being the equivalent of one pound of water evaporated into steam). The charge for steam is based principally on the direct use of same by meter. There are, however, other charges, usually of a minor character, depending on the conditions of supply. The meter charge for the regular supply of steam used will in general be a definite rate per thousand kals, based on the average weekly consumption during the month, in accordance with the "Graduated Scale of Prices" of the company, of which the following is an abstract:

Rates charged for steam per thousand kals.	Consumption of steam in kals during times stated below, required to fix rates in first column.		
Cents.	3 Weeks.	4 Weeks.	5 Weeks.
80.15	8,505	11,340	14,175
77.6	12,660	16,880	21,100
75.1	17,130	22,840	28,550

The full table contains 820 lines similar to the above, and provides proportional rates for intermediate quantities of steam.

(474) H. E. W., Lillay, Ark., writes: I have in a battery three boilers, each 24 feet long; in each, two flues. These boilers are connected to steam and mud drums, and fed by an inspirator through the mud drum. This manner of feeding the boilers has always been a source of trouble, cracking the plates so as to require patches. I am thinking of taking the drums out and dispensing with one entirely and feeding the boilers in the following manner: Parallel to the front of the boilers I intend to run a 4-inch pipe, and perpendicular to this pipe, three 2-inch branch pipes, one to each boiler. At the ends of the 4-inch pipe, I intend to place a globe valve and designate these valves by the letters *A* and *B*. Outside of the globe valve *B*, the inspirator is to be placed. Now to feed the boilers, I open the valve *B* and close *A*; and in order to blow off the boilers, I open the valve *A* and close *B*. Will this arrangement be a good one? *A.*—We do not like the arrangement, and do not consider it to be good practice. Separate pipes should be used for feeding and blowing off the boilers. For feeding, each boiler should have a check valve, so that the amount of feed water can be regulated for each boiler; or the feed closed to one or two boilers, as the case may require, and feeding into the remaining boilers only. Good and satisfactory results will be obtained by entering the feed into the front of the boiler, and lead it through a pipe into the back end, where the water is usually the coldest. For blowing off, each boiler should have a valve, so as to blow off one or more boilers while the others are left undisturbed. Feeding through the mud drum, we consider to be bad practice, particularly so in your case, because, judging from your complaint of trouble, the mud drum must be in hot part of the boiler. The feed should always enter a comparatively cold part of the boiler; and the blow-off should be placed directly on the bottom of the boiler in a plane with the end of the internal feed pipe, providing circumstances will permit. As to dispensing with one of the drums, we assume you mean the mud drum, which we believe to be a good idea, as we are not in favor of the mud drums. But if the present conditions or design of boilers and machinery require a steam drum, we do not see how you can dispense with it. If the water is bad, you may require a surface blow.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p 16.

Link-Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Small Electric Arc Light Plants,

3, 5 and 10 arc lights and up,

Waterhouse Electric & M'f'g Co., Hartford, Ct.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb-Knitting Machine Co., Chicopee Falls, Mass.

See our new designed engine lathes in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed drill presses in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed shapers in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed brass working tools in Cincinnati Centennial Exposition, Lodge, Davis & Co.

2,000 feet of space in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See special adv't, page 16, Lodge, Davis & Co.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"How to Keep Boilers Clean." A book mailed free by James E. Hotchkiss, 120 Liberty st., N. Y.

Mechanical drawing, calculations, etc., taught by correspondence. I. Donald Boyer, Dayton, Ohio.

Pattern letters and figures to place on patterns for castings. H. W. Knight & Son, Seneca Falls, N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W. Washington, D. C. Send for pamphlet and references

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

J. W. Strange, Bangor, Me.—Dear Sir: We prefer your steel stamps to those of any other make. Darling, Brown & Sharpe, Providence, R. I.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N. Y.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Oct. 6, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A system of easy lettering by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Sept. 22, 1888 issue, 59 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 73 articles have thus far appeared up to and including the Sept. 15, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES.

An iron foundry will be started at Athens, Ga., by R. Lucas.

The Perry Stove Works will rebuild at South Pittsburgh, Tenn.

The Chattanooga (Tenn.) Plow Factory will double their capacity.

The Milner Lumber Company will build a saw mill at Bluff Springs, Fla.

The Knoxville (Tenn.) Sash and Door Company are putting in machinery.

Burgess Brothers are interested in building a cotton mill at Liberty, N. C.

The Morgan Lumber Company, Glens Falls, N. Y., are building a planing mill.

The Anniston (Ala.) Pipe Works have increased their capital stock to $500,000.

The Somerset Woolen Mills at East Madison, Maine, are again in operation.

The Flambeau Water Power Company are building a pulp mill at Flambeau, Wis.

The Reed Shoe Company, at Lynn, Mass., will build a factory at Kennebunk, Maine.

The Memphis (Tenn.) Furniture Company are building a factory to employ 100 hands.

An excelsior factory has been started at East Madison, Maine, by Reed & Thompson.

An addition 50 x 110 feet will be made to the Draper machine shops at Hopedale, Mass.

The Brown Self-Sharpening Mowing Machine Company has been organized at Kittery, Maine.

The Haskell & Barker Car Works, Michigan City, Ind., will build a blacksmith shop 130 x 164 feet.

The Baltimore & Ohio Railroad Company will build a new wood-working shop at Grafton, W. Va.

McAfee & Tolbert are building a wood-working factory at Canton, Ga.; they expect to build a cotton gin.

The Cartersville Steel and Furnace Company, Cartersville, Ga., have decided to build an iron furnace.

It is said that the new shops to be built by the Memphis & Charleston Railroad at Sheffield, Ala., will cost $300,000.

The Pioneer Mining and M'f'g Co., Birmingham, Ala., will begin to increase the capacity of their plant early in November.

The Tacoma Cedar Lumber Company, Tacoma, W. T., has been incorporated. The company will manufacture shingles and cedar lumber.

The American Wire Nail Works, Covington, Ky., have increased their capital stock to $500,000. The company will build a rod mill and a wire mill.

The Roanoke (Va.) Machine Works will double the size of their car works, and will also materially increase the size of their machine shop, and other departments.

The Babcock & Wilcox Company sold 16,200 horse-power of boilers in the month of September. This is perhaps the largest horse-power ever sold in a month by one company.

The Chelmsford Foundry Company, North Chelmsford, Mass., are building an addition to their machine and pattern shops, 30 x 80 feet. They will put in several new machine tools.

The R. F. Hawkins Iron Works, Springfield, Mass., have issued a catalogue of the triple draft tubular steam boilers made by them. The catalogue is illustrated, and contains a description of these boilers.

An old subscriber, D. Waye Matthiesen, writes us from Stockholm, Sweden, that he is preparing to start in the manufacture of small hardware, and says, "I won't forget your valued paper all the time, I guess."

M. A. Lapham, Millbury, Mass., is building an addition to his woolen mill 40 x 40 feet; also an addition to picker room 25 x 36 feet, both two stories high. He is besides building an addition to finishing room 21 x 50 feet, and will put in a new steam engine.

The Herendeen M'f'g Co., Geneva, N. Y., send us their new catalogue of steam and hot water heating, also an essay on the heating of greenhouses. The company manufacture the Furman boiler for heating purposes; this is a low-pressure boiler, and automatically controlled.

The following record of the Leavitt pump, at the Lynn (Mass.) water-works, is a good one. It is for the month of September: Pumped 72,903,376 gallons of water, number of pounds of coal used, 103,950; number of gallons of water pumped per pound of coal, 703.3; average duty for the month, 102,951,317 gallons.

Hughes & Horton, proprietors of the Lowville Iron Works, Lowville, N. Y., began work about 18 months ago, employing four or five men. Now they are employing 14 men and are building an addition 30 x 40 feet, to their machine shop. They build pulp mill machinery, and do general mill work and jobbing.

A press dispatch says: The extensive car shops near Bordentown [N. J.], owned and operated by the Camden and Amboy Railroad Company, have been sold to the King Locomotive Works, of New York, who will use them for repairing locomotives, cars, and as storage shops. The company will employ about two hundred men. The works are now being fitted up.

Machinists' Supplies and Iron.

NEW YORK, Oct. 11, 1888.

Iron—American Pig—No changes of any importance have taken place either in prices or the condition of trade. We quote Standard Lehigh and North River brands $18.50 to $19 for No. 1 X Foundry ; No. 2 Foundry, $17 to $17.50, and Grey Forge $15.50 to $16.25.

Scotch Pig—The market has ruled quiet and prices are unchanged. We quote Coltness, $21.75 to $22 ; Gartsherrie, $21 ; Summerlee, $21.75 to $22 ; Eglinton, $19.25 to $19.50 ; Dalmellington, $20.25 to $20.50 ; Clyde, $20.50, and Langloan, $20.50.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 90 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes ; see p. 11.

Wanted—Travelers for New England and Middle States, to handle mechanical goods ; liberal commission. Box 17, AMERICAN MACHINIST.

Wanted—Work at machine pattern making by experienced stove pattern maker, with some exp. on machine work ; best ref. Pattern, AM. MACHINIST.

Wanted—Re-engagement as foreman, by thorough, practical and clever machinist, well up in all branches ; highest references. B., AM. MACHINIST.

Wanted—In mfg. business, position as foreman or workman ; general machinist, tool, die, and metal pattern maker ; exp'd. Box 150, West Gardner, Mass.

Wanted—A machinist and tool maker on metal cutting, dies and general machine work ; also an apprentice in machine shop ; steady job for right party. C. & M., 234 W. 29th st., New York City.

A superintendent soon at liberty desires to re-engage ; locomotive and heavy machine work, foundry work, heating furnaces and forgings ; boilers and steam work. C. M., care AM. MACHINIST.

Wanted—Position as machinery salesman, by a young man who has had three years' experience as a machinist in a first-class shop ; best references. H., AMERICAN MACHINIST.

A young man wants permanent employment as mechanical draftsman ; is a machinist and college graduate, with 8 years' exp. in m'f'g and designing of machinery ; best refs. P. M., AM. MACHINIST.

Wanted—Position by a man of 16 years' experience in the machine business, as mechanical sup't. or foreman of some manufacturing establishment or machine shop. Box 33, AMERICAN MACHINIST.

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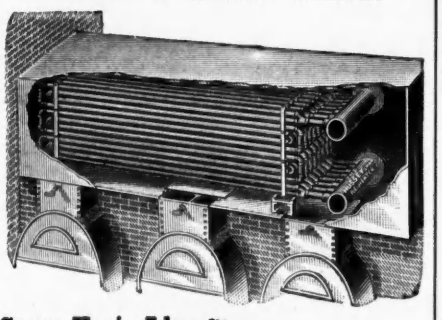

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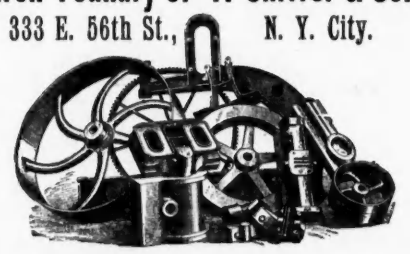

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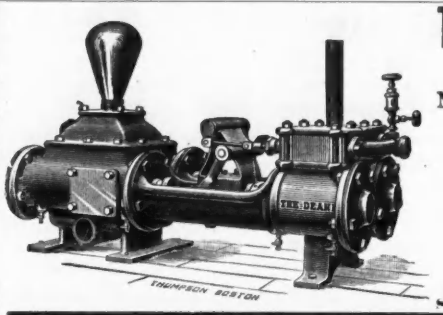

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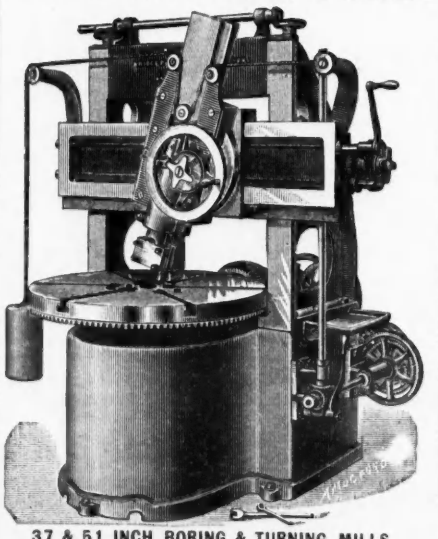

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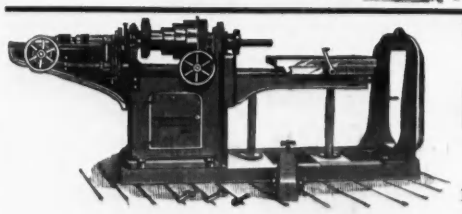

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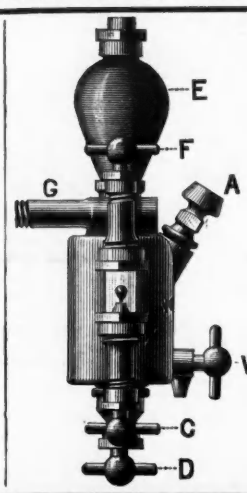

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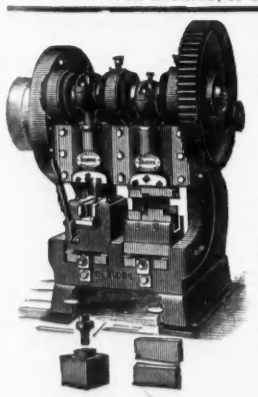

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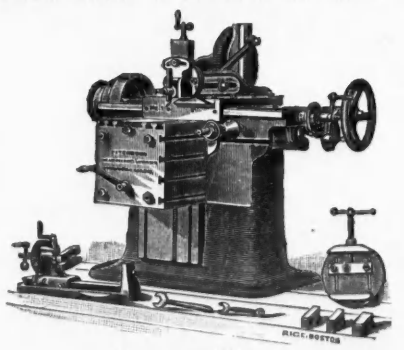

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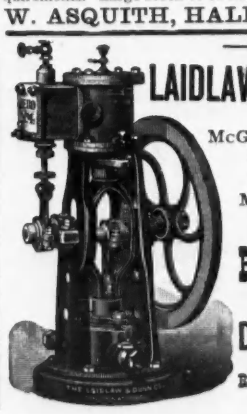

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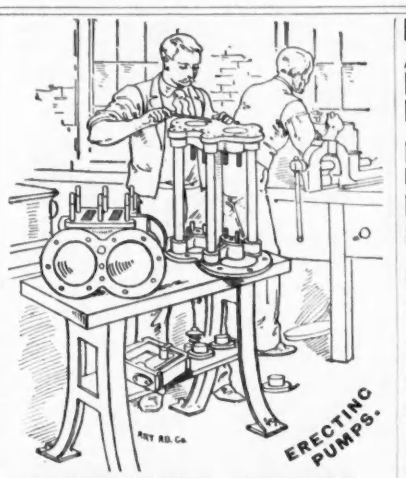

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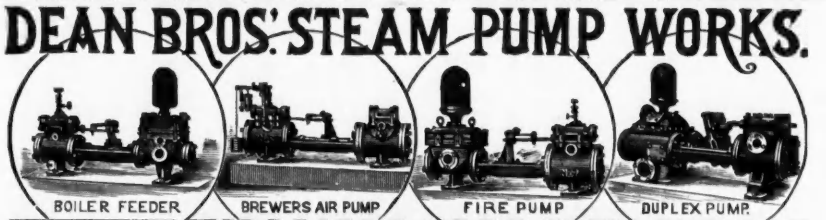

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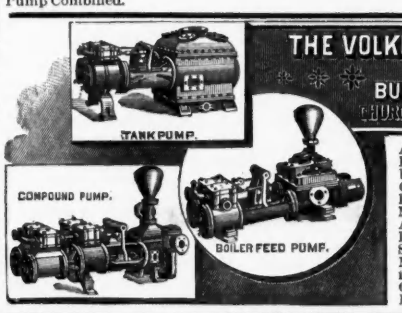

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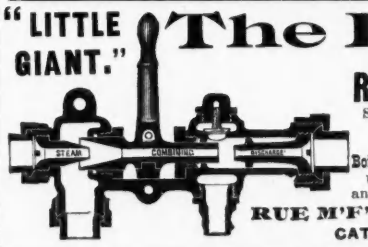

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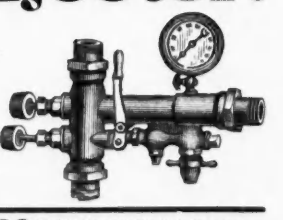

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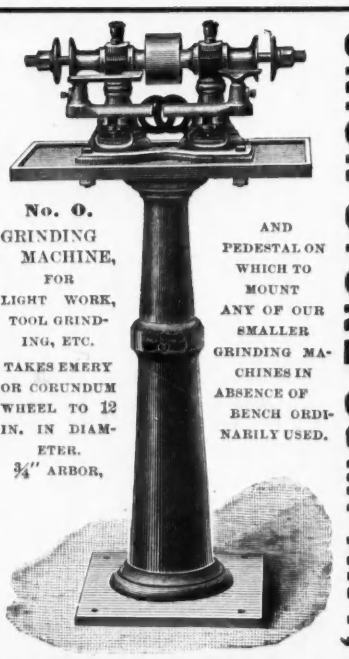

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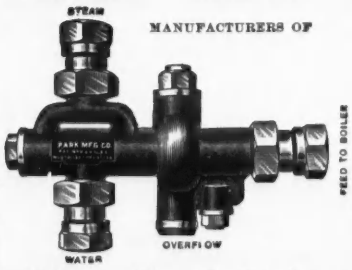

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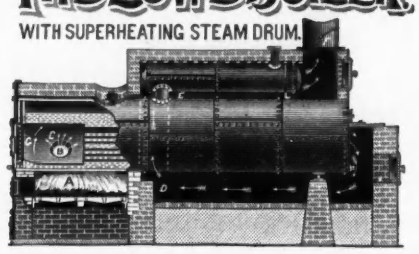

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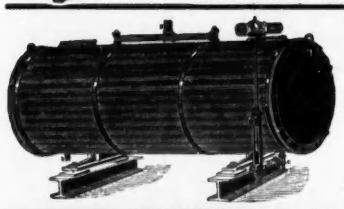

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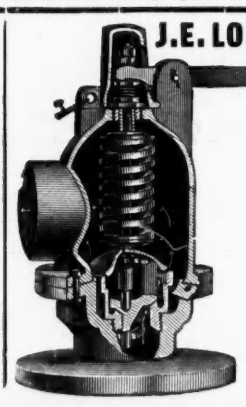

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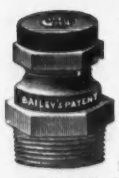

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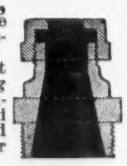

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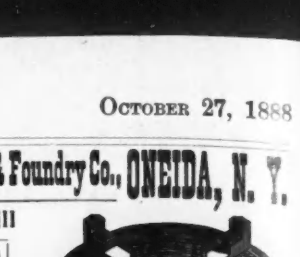

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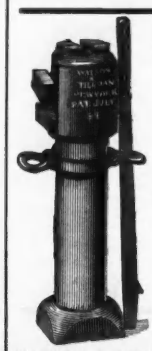

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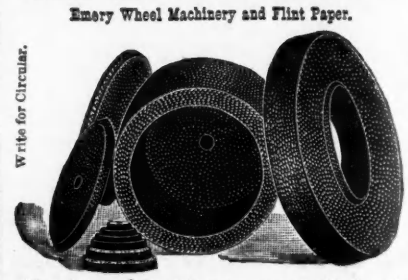

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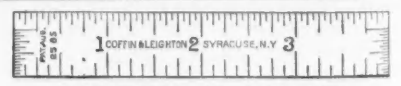

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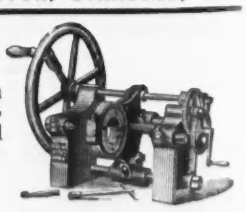

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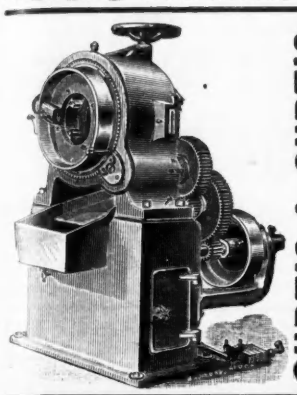

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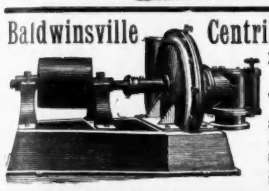

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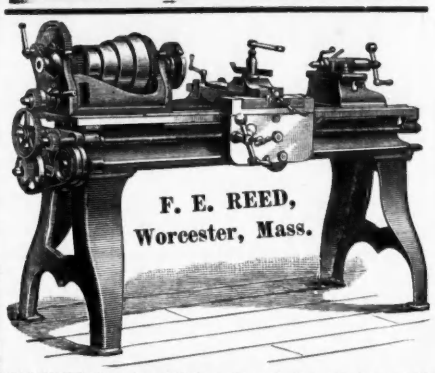

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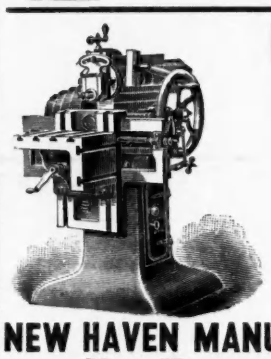

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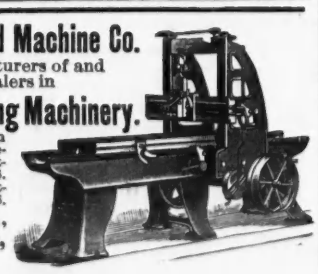

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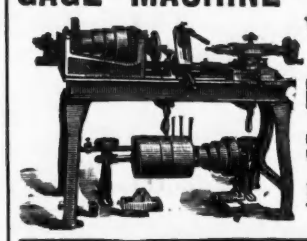

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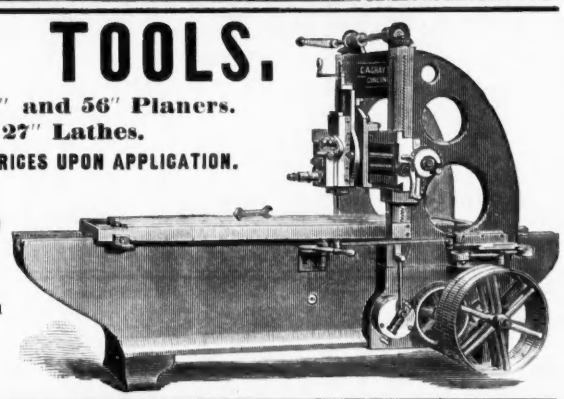

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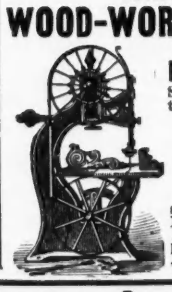

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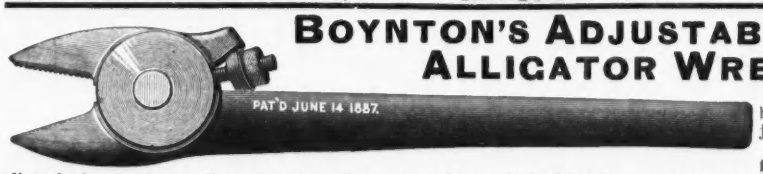

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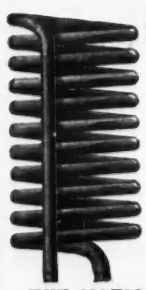

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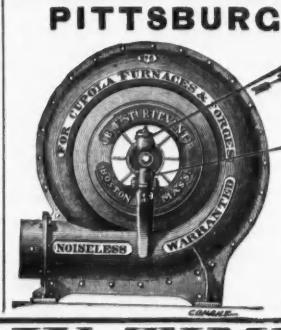

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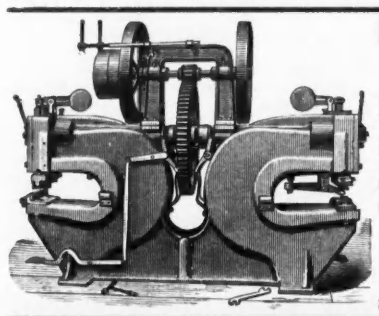

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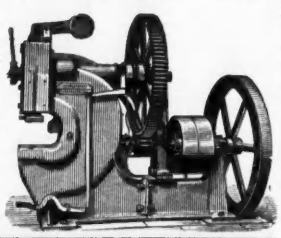

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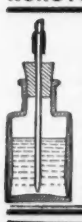

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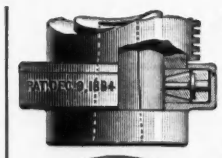

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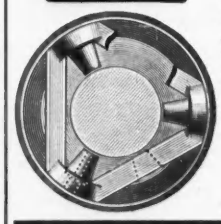

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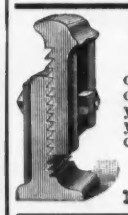

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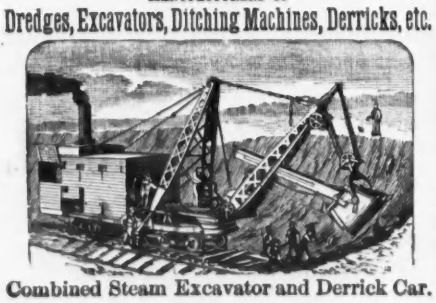

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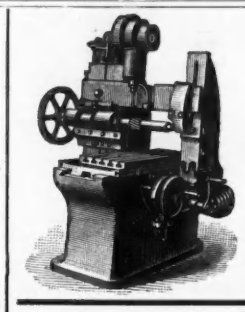

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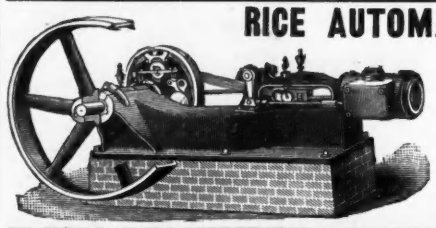

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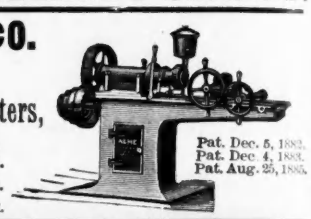

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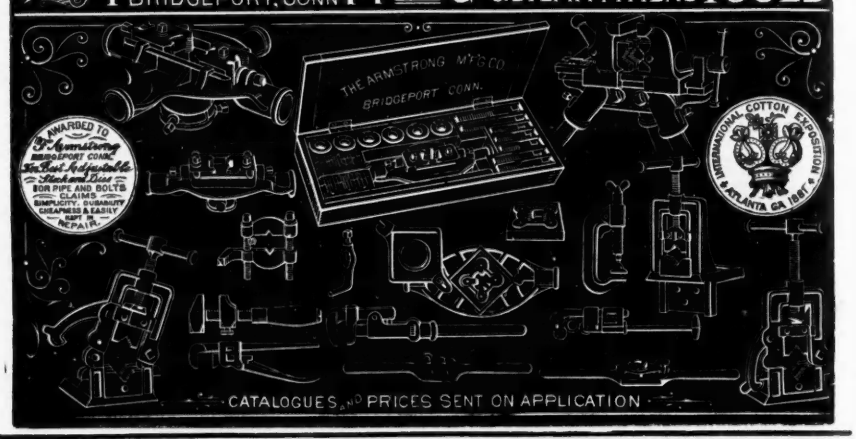

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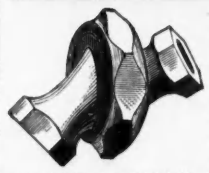

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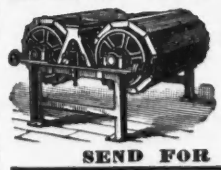

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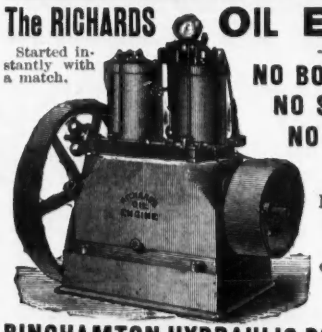

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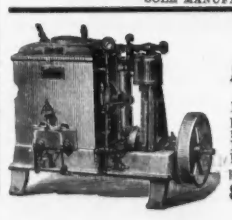

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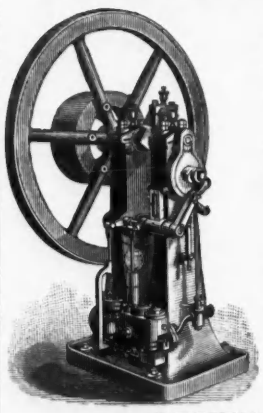

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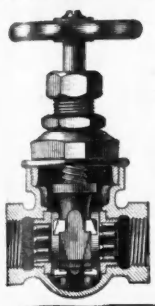

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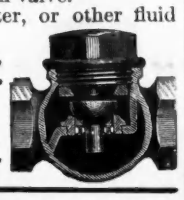

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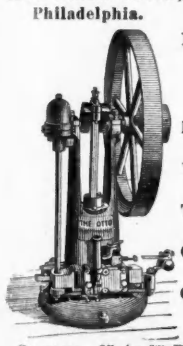

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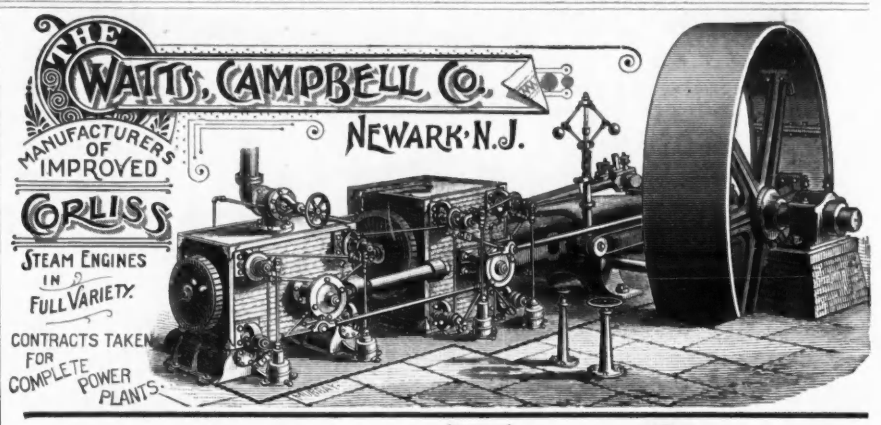

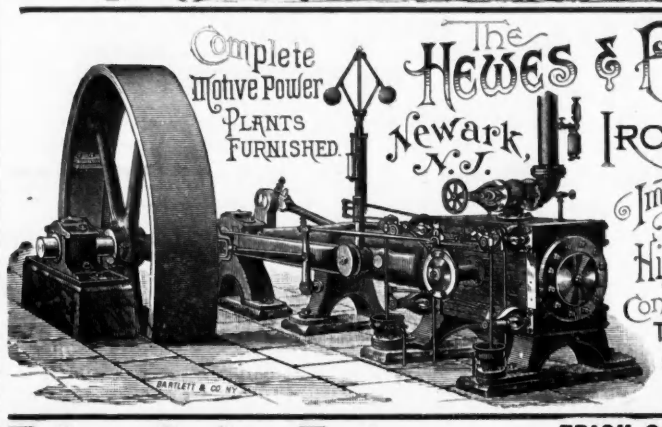

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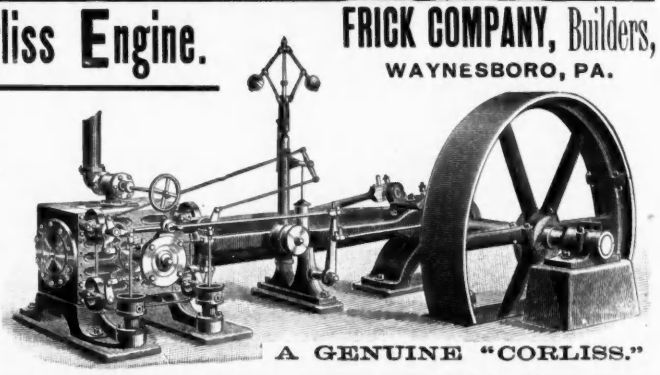

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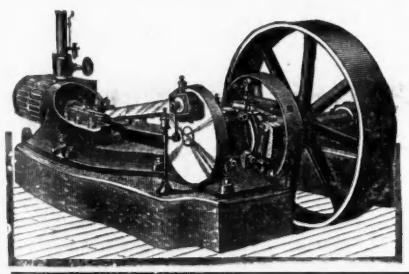

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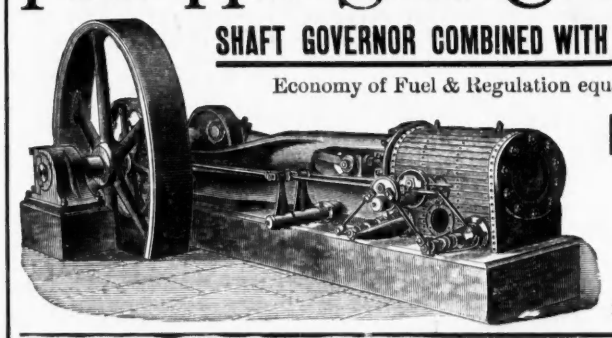

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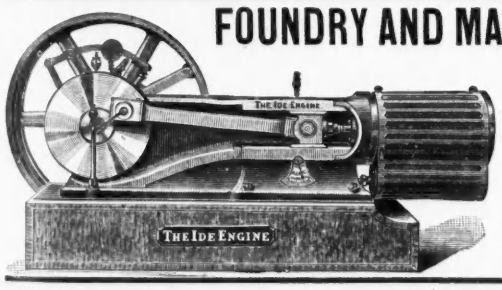

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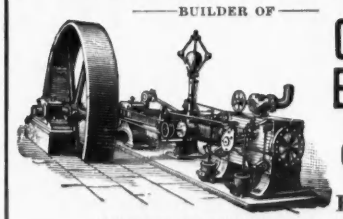

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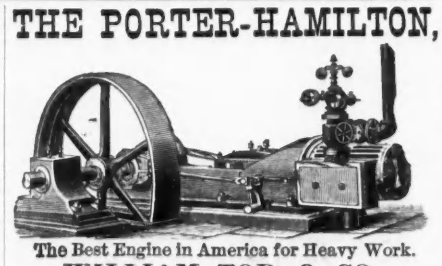

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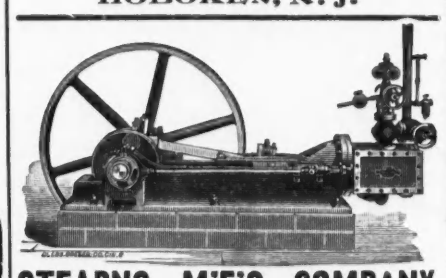

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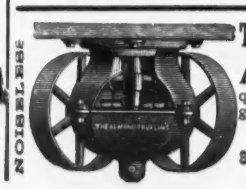

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INSERTED TOOTH MILLS, END MILLS,

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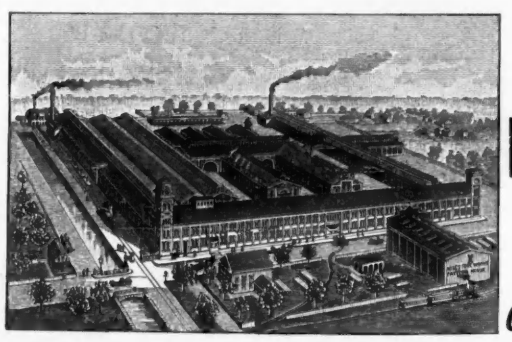

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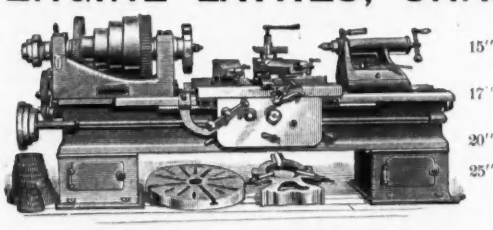

15″ 20″ 26″ 32″ Shapers.

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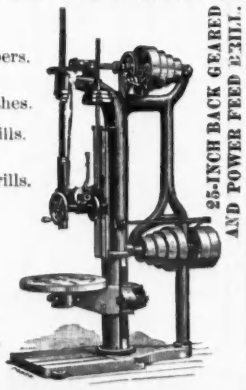

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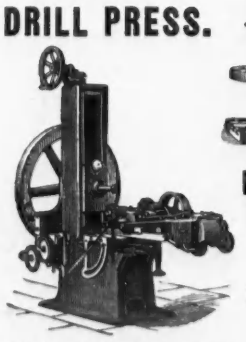

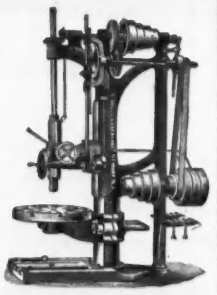

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Sizes, 18″, 25″, 36″, 50″, 60″, 84″.

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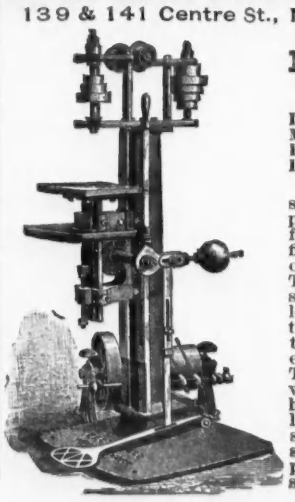
Including Milling Machines, Drill Presses, Hand Lathes, &c.



The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

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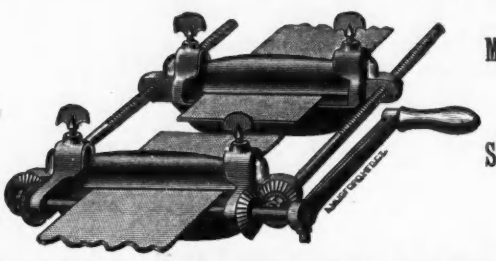

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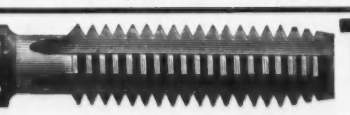

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